
# TECHNICAL GUIDANCE FOR THE OFFICE OF WATER QUALITY EXTERNAL DATA FRAMEWORK

PREPARED BY:

Jody Arthur

Watershed Assessment and Planning Branch

Watershed Assessment and Planning Branch

Indiana Department of Environmental Management (IDEM)

Office of Water Quality

100 North Senate Avenue

MC65-40-2 Shadeland

Indianapolis, Indiana 46204-2251

September 23, 2015

# FORWARD

This guidance is an extension of the Watershed Assessment and Planning Branch, *General Guidance for the Office of Water Quality External Data Framework*, which is available online at: http://in.gov/idem/cleanwater/2485.htm. The purpose of the general guidance is to provide an overview of the External Data Framework (EDF) and to address some of the more common questions regarding its structure, policies and participation. This technical guidance provides a detailed description of the requirements and recommendations of the EDF.

# TABLE OF CONTENTS

# TABLES

# FIGURES

# 1 INTRODUCTION

The External Data Framework (EDF) is a process developed by the Indiana Department of Environmental Management (IDEM) Office of Water Quality (OWQ) to provide a systematic, transparent, and voluntary means for external organizations to submit their water quality data to IDEM for consideration in various OWQ programs.

All water quality data submitted through the EDF are considered by OWQ to be secondary data. Secondary data are existing data collected by individuals and organizations outside of the OWQ for their own purposes and as such may or may not be suitable for OWQ program uses.

The primary purpose of this guidance document is to help those interested in sharing their water quality data with OWQ understand how the EDF works and determine the criteria they must meet in order for OWQ to consider their data for one or more specific programmatic purposes. Specifically, this document identifies:

- The purposes for which OWQ may use secondary data
- The types of data OWQ accepts through the EDF and guidelines for data submittals
- OWQ's quality assurance, quality control, and other requirements for the use of secondary data
- OWQ's data quality assessment process for determining the reliability of secondary data sets for use in its programs

Links to additional resources and and information on where to get technical assistance are also provided at the end of this document.

In addition to the technical guidance provided for EDF participants, there are a number of recommendations here that external organizations can use to develop their own monitoring plans, improve the quality of the data they collect and determine whether data sets they obtain from other organziations are suitable for use in their own projects.

# 2 POTENTIAL USE OF SECONDARY DATA BY IDEM'S OFFICE OF WATER QUALITY AND OTHERS

The Office of Water Quality's (OWQ's) ability to use secondary data in its programs is determined on a case-by-case basis and depends on the quality of the data set being considered. The External Data Framework (EDF) is based on two primary principles, both of which are reflected in its tiered structure and data quality assessment process:

1. The quality of a data set is directly related to the scientific rigor with which it was collected.
2. Data quality is only meaningful when it relates to the intended use of the data.

The level of data quality necessary in a data set is determined by the individual or organization collecting the data usually based on a combination of factors including the monitoring resources available, the intended use of the data, and the stakes associated with that use. Some uses require very high quality data that are legally defensible while for others, a scientifically rigorous data set with some but fewer quality controls may suffice. Because data quality can vary significantly from one data set to another, in order to use data sets from external sources, OWQ must first evaluate the data set against its own set of requirements to determine the use(s) for which it may be reliable.

When a secondary data set is received through the EDF, OWQ will first conduct a data quality assessment of the data package to determine the level of scientific rigor with which it was collected and the resulting analytical quality of the data set. Within the context of the EDF, scientific rigor means that:

- Field and laboratory procedures for sample collection and analysis followed documented procedures, and the data collection and storage procedures employed can be verified if necessary
- Data collection activities include sufficient controls to ensure the quality of the resulting data set is commensurate with its intended use

OWQ's data quality assessment process for secondary data is based on the same system OWQ uses to verify and validate its own data for use in OWQ programs. This process, which is described in more detail in Section 7, reviews the quality assurance and other documentation provided with the data package to ensure it contains all the information needed to determine the quality of the data set (verification) and the individual results to identify any error and determine the analytical quality of the data set (validation). Based on OWQ's data quality assessment, the data set will be assigned one of three data quality assessment (DQA) levels.

While the DQA level provides a measure of the reliability of a data set in terms of the scientific rigor with which it was collected and its resulting analytical quality, the DQA level does not define specific uses for a data set. Each DQA level has a cooresponding tier in the EDF that identifies the potential uses for which OWQ considers a data set reliable (Figure 1).

OWQ has identified several common uses for water quality data – including its own uses and a number of other, non-OWQ uses – and has placed each into one of three EDF tiers based on the level of data quality (as indicated by the DQA level) that OWQ considers necessary to support it.

As noted before, data quality is only meaningful when it relates to the intended use of the data –by associating specific uses with DQA levels through the tiered structure of the EDF, OWQ ensures that the quality of any secondary data received is commensurate with OWQ's intended uses. For non-OWQ uses, the EDF tiers and their associated DQA levels are provided as recommendations to help individuals and organizations outside of OWQ determine if the data they collect or obtain from others are reliable for their needs.

**Figure 1: Relationship between the general data quality charactieristics of each of the three data quality assessment (DQA) levels and the kinds of uses identified within their associated tiers of the External Data Framework (EDF).**

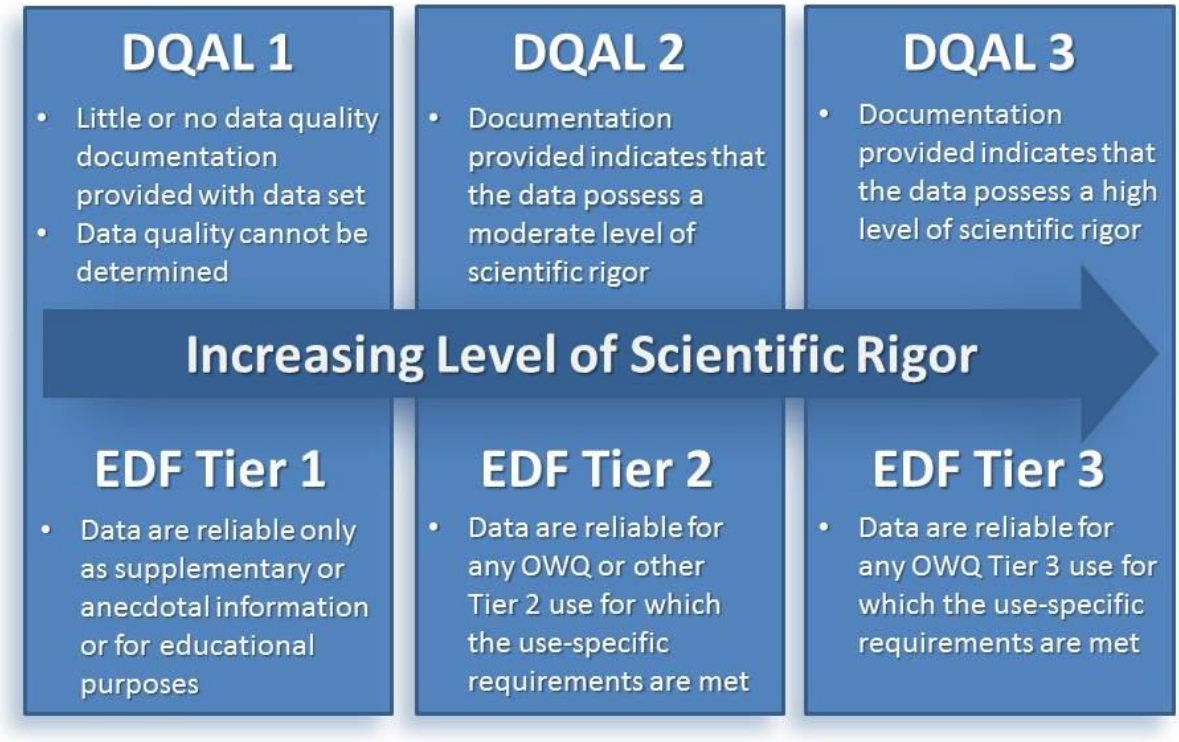



Table 1 identifies the purposes for for which OWQ may use data received through the EDF, as well as a number of othe non-agency uses for water quality data. With regard to non-agency uses, the uses shown reflect some of the more common uses for monitoring data at the local level by watershed groups, municipalities, colleges and universities, etc. Some of these uses apply to both lakes and streams while others apply only to one or the other[1].

It is important to note that in Table 1, Tiers 1 and 2 represent the minimum level of data quality OWQ considers appropriate to for the uses shown. OWQ always recommends using the highest quality data available for the uses identified in these tiers.

Table 1 is also intended to help EDF participants more easily find the information they need to determine whether their data are reliable for one/more a specific uses. The "Use Key" associated with each use in Table 1 identifies the specific EDF requirements and recommendations associated with that use that are provided in other tables and sections throughout this document including:

- The types of parameters suited to each use, including water column parameters (Table 2), biological communities (Table 3) and fish tissue parameters (Table 4)
- Uses that require results for more than one parameter (Table 5)
- Guidelines on when to conduct follow-up monitoring to showing water quality improvements resulting from the implementation of best management practices (Table 6)

[1] The EDF was developed to accommodate water quality data collected from flowing waters (rivers and streams) and lentic waterbodies (lakes and reservoirs). At this time, the EDF does not accommodate water quality data collected from wetlands.

- Requirements and recommendations regarding frequency and timing of monitoring activities and data minimums (Table 7)
- Quality control procedures that will ensure the resulting data will be or are reliable for the intended use(s) (Tables 8-16). Data quality objectives OWQ considers appropriate for each tier in the EDF based on data type (Section 8.2)

**Table 1: Potential uses for data received through the External Data Framework.**

| EDFTier | Use Key | EDF Data Uses | Waterbody Type(s) |
|---|---|---|---|
| OWQ Uses (identified in the Use Key with an "A") | | | |
| 3 | A1 | Clean Water Act (CWA) Section 305(b) aquatic life use support assessments and Section 303(d) listing decisions (within the Great Lakes Basin) | Streams |
| 3 | A2 | CWA Section 305(b) aquatic life use support assessments and Section 303(d) listing decisions (outside the Great Lakes Basin) | Streams |
| 3 | A3 | CWA Section 305(b) recreational use support (human health) assessments and Section 303(d) listing decisions | Lakes and Streams |
| 3 | A4 | CWA Section 305(b) fishable use support assessments and Section 303(d) listing decisions | Lakes and Streams |
| 3 | A5 | CWA Section 305(b) drinking water use support assessments and Section 303(d) listing decisions (within the Great Lakes Basin) | Streams |
| 3 | A6 | CWA Section 305(b) drinking water use support assessments and Section 303(d) listing decisions (outside the Great Lakes Basin) | Streams |
| 3 | A7 | Water quality modeling for total maximum daily load (TMDL) development | Streams |
| 3 | A8 | Demonstrating effectiveness of watershed restoration efforts funded by OWQ's Nonpoint Source (NPS) Program | Lakes and Streams |
| 3 | A9 | Determining representative background conditions for the purpose of developing National Pollutant Discharge Elimination System (NPDES) permits | Streams |
| 3 | A10 | Classifying waters for the purpose of determining the necessary requirements new permittees must meet to comply with antidegradation rules in Indiana's Water Quality Standards | Streams |
| 2 | A11 | CWA Section 305(b) recreational use support (aesthetics) assessments and Section 303(d) listing decisions for lakes | Lakes |
| 2 | A12 | CWA Section 314 assessments of trophic status and trends in lakes | Lakes |
| 2 | A13 | Supplementary information for use in planning and prioritizing OWQ monitoring efforts for TMDL development, MS4 program development and prioritization, watershed characterization studies and other projects | Lakes and Streams |
| 2 | A14 | Demonstrating the effectiveness of watershed management plan and/or TMDL implementation over time (incremental improvements that meet U.S. EPA performance measures) | Lakes and Streams |
| 2 | A15 | Establishing need for low interest loans to assist with formation of regional sewer and water districts (RSWDs) | Lakes and Streams |
| 2 | A16 | Supplementary information for use in evaluating loan applications for drinking water and wastewater infrastructure improvements through the Indiana State Revolving Loan Fund (SRF) | Lakes and Streams |

| | | | |
|---|---|---|---|
| 2 | A17 | Supplementary information for use in evaluating CWA Section 401 applications and isolated wetland permit applications, and identifying potential wetland mitigation sites | Streams |
| 1 | * | Supplementary information for use in TMDL development | Lakes and Streams |
| 1 | * | Supplementary information for OWQ's Integrated Report | Lakes and Streams |
| Non-OWQ Uses (identified in the Use Key with a "B") | | | |
| 2 | B1 | Watershed management planning | Lakes and Streams |
| 2 | B2 | Demonstrating the effectiveness of measures recommended in a watershed management plan or an approved TMDL to increase public awareness, support and involvement | Lakes and Streams |
| 2 | B3 | Demonstrating effectiveness of minimum control measures specified in municipal separate storm sewer system (MS4) storm water quality management plans, permits or improvements over time to increase public awareness, support and involvement | Streams |
| 2 | B4 | Demonstrating the effectiveness of measures implemented as part of a community's long-term combined sewer overflow (CSO) control plan | Streams |
| 2 | B5 | Screening for potential recreational use issues related to human health | Lakes and Streams |
| 2 | B6 | Screening for potential recreational use issues related to aesthetics | Lakes |
| 2 | ** | Determining water quality trends over time | Lakes and Streams |
| 1 | * | Education and raising awareness of water resource issues | Lakes and Streams |

*No key is provided because Tier 1 of the EDF is associated with data of unknown quality (see Figure 1). As such, this guidance does not articulate any requirements or recommendations for these uses.

OWQ welcomes any and all water quality data any individual or organization wishes to provide through the EDF. If a data set does not "fit" into one of the uses described in Table 1, OWQ and others may find it useful for purposes not previously anticipated, and Table 1 may expand to articulate those uses. For example, OWQ continually works to develop and revise Indiana's numeric water quality criteria. Although no criterion currently exists for some parameters, water monitoring results for those parameters may be useful for water quality assessments or other purposes in the future, once applicable criteria have been developed. Likewise, a data set may also be useful in the development of assessment methodologies, particularly those that implement the narrative water quality criteria in the State's water quality standards.

## 2.1 Additional Considerations Regarding Office of Water Quality's Use of Secondary Data

OWQ's ability to conduct follow-up monitoring based on secondary data is resource-dependent. Thus, it is possible that external data submitted for this purpose may not result in additional monitoring by the OWQ, if the necessary staff and other resources are not available.

The amount, type and quality of data available through the EDF are just a few of the factors OWQ must consider when determining its monitoring priorities[2]. This said, with regard specifically to TMDL development, any data submitted to OWQ through the EDF will be considered. OWQ considers data collected by external organizations indicative of active interest on the local level in making water quality improvements. This information can be used in the TMDL to provide reasonable assurance to U.S. EPA that the measures recommended in the TMDL will be implemented.

When demonstrating the effectiveness of watershed management plan or TMDL implementation, the minimum number of water quality sample results depends on whether the goal is to show incremental improvements or full restoration of an impaired waterbody. Tier 2 data may be used to show incremental improvements. However, in order to demonstrate full restoration, as evidenced by the removal of a waterbody from the Indiana's 303(d) List of Impaired Waters, data provided through the EDF must meet Tier 3 requirements.

The designated beneficial uses described in Indiana's water quality standards[3] (WQS), and the narrative and numeric criteria to protect them, provide the underpinning of most of the OWQ's Tier 3 decision making processes. Therefore, data submitted for Tier 3 uses will be more usable if they relate to a water quality standard or one or more designated beneficial uses articulated in the State's WQS. Due to the regulatory nature of most Tier 3 uses, all data submitted for consideration in OWQ's Tier 3 processes must have a level of scientific rigor comparable to the data that OWQ collects.

# 3 How to Submit Water Quality Data to the External Data Framework

OWQ has developed a Secondary Data Portal to facilitate water quality data submissions from external sources. The Secondary Data Portal provides different options for submitting data. The portal provides access to a number of options available to facilitate greater data sharing with the OWQ including user-friendly online data entry and Microsoft (MS) Excel templates customized for the organization submitting the data.

---

[2] The factors OWQ considers in determining its monitoring priorities are discussed in the *Indiana Water Quality Monitoring Strategy. 2011-2019* developed by IDEM's Watershed Assessment and Planning Branch available online at: [insert link; See email convo w/Lou on 20140903].

[3] Indiana's water quality standards are provided in Indiana Administrative Code (IAC 327, Article 2).

OWQ accepts secondary data through the following four programs:

- OWQ's External Data Framework (EDF)
- OWQ's Nonpoint Source (NPS) Program
- Hoosier Riverwatch
- The Indiana Clean Lakes Program

Although this guidance is intended for EDF participants, data submittal processes for the other programs noted aboce are discussed briefly in this section to help individuals and organizations interested in submitting their water quality data to OWQ (or required to by a grant agreement) determine which options are available to them.

## 3.1 OWQ Nonpoint Source Program Grantees

Organizations that are conducting water quality monitoring under a Nonpoint Source Program grant agreement have two options for submitting their data to IDEM using either the online data entry forms or a downloadable MS Excel spreadsheet that once completed, can be uploaded to the data entry page.

## 3.2 Volunteers Monitoring through the Indiana Clean Lakes and Hoosier Rivewatch Programs

Volunteers participating in the Indiana Clean Lakes and/or the Hoosier Riverwatch programs do not need to participate in the EDF to have their data considered for potential use in OWQ programs. Indiana Clean Lakes Program and Hoosier Riverwatch volunteers can be confident that their data will automatically be considered for Tier 1, and possibly Tier 2, uses through OWQ's ongoing partnership with these programs.

The Indiana Clean Lakes Program is not an internal OWQ program. This program is administered by the Indiana Univeristy School of Public and Environmental Affairs (IU-SPEA) with support from OWQ's NPS Program. Volunteers in the Indiana Clean Lakes Program send their field data to IU-SPEA on post cards, via email or by entering results directly into the program web site. Advanced volunteers also collect water and algal samples, which are sent to the IU-SPEA laboratory for analysis. With the exception of field data entered directly by volunteers, all volunteer monitoring results for Indiana lakes are entered into the Indiana Clean Lakes Program database by staff and students at IU-SPEA. These results are routinely provided to OWQ as part of the program's grant agreement.

Hoosier Riverwatch is an OWQ program through which volunteers receive training on stream monitoring. Volunteers that complete the Hoosier Riverwatch training are encouraged to enter their stream water quality data directly into the Hoosier Riverwatch online database. Because Hoosier Riverwatch is an OWQ program, these data are readily available for potential use by OWQ programs.

## 3.3 Submitting Data through the External Data Framework (EDF)

All other organizations and individuals interested in sharing their data with OWQ may do so through the EDF. Submittals through the EDF are not time-sensitive and are accepted year round.

EDF participants may enter their data online or request a customized MS Excel template through the Secondary Data Portal and upload their completed templates to the data entry page. In addition to these options, OWQ also provides technical assistance to organizations with larger, more complex data sets to facilitate sharing their data through an Electronic Data Interchange (EDI) if needed.

Generally, participants with smaller and/or less complex Tier 1 and Tier 2 data sets will find online data entry easier to use than the MS Excel templates. Those with larger, more complex data sets and/or ongoing monitoring programs will likely find the templates a better option. Participants may choose any of these options or work one-on-one with OWQ quality assurance staff to develop an EDI Participants may choose the option that best fits their needs.

Data quality documentation should provide sufficient information to determine the quality of a given data set through comparison with the data quality objectives (DQOs) for one or more OWQ uses, which are discussed in more detail in Section 8 of this guidance. A quality assurance project plan (QAPP) is preferred because it is designed to include all the information needed to answer any questions OWQ may have regarding the accompanying data. OWQ provides a template and online guidance to assist EDF participants in the development of a QAPP at: http://www.in.gov/idem/nps/3383.htm

## 3.4 OWQ's Secondary Data Certification

Prior to using secondary data for its Tier 2 or Tier 3 uses, OWQ must certify the data set. Certification provides an added layer of confidence that OWQ has received or can easily obtain all the information needed to support the DQA level assigned to the data set. All data submittals that participants wish to have OWQ programs consider for Tier 2 and Tier 3 uses must contain a certification form completed by the individual or organization and returned with each submittal. This form is provided in Appendix 1.

## 3.5 Data Submittals in Hard Copy

The Secondary Data Portal was built to accommodate data submittals in electronic format to facilitate their entry into OWQ's Assessment Information Management System (AIMS) database. Getting secondary data sets into the AIMS database via the Secondary Data Portal significantly streamlines their review and makes them readily available for potential use by OWQ programs.

OWQ accepts water quality data and reports in hard copy format through the EDF. However, the staff resources available to evaluate paper submittals are limited. Given this, data quality review and ranking of hard copy submittals will be conducted as time allows. Based on OWQ's data quality assessment process, data of unknown quality are ranked as DQA Level1. Thus, OWQ must consider all data sets submitted in hard copy suitable only for Tier 1 uses until their data quality can be ascertained. If OWQ is able to perform a thorough data quality assessment of a hardcopy data set and finds that it meets the requirements for DQA Levels 2 or 3, the data may then be considered for additional associated Tier 2 and Tier 3 uses.

Hard copy data submittals can be sent directly to the Secondary Data Coordinator via email at: WaterQualityEDF@idem.IN.gov or by regular mail to:

Carol Newhouse, Secondary Data Coordinator
IDEM Office of Water Quality
100 North Senate Avenue
MC 65-44 Shadeland
Indianapolis, IN 46204-2251
317-308-3392; 800-451-6027 (toll free)

### 3.6 Data Submittals by Third Parties

OWQ defines third-party data submittals as data sets coming from individuals or organizations other than those that collected the data. OWQ welcomes such data submittals through the EDF. OWQ recommends that individuals and organizations submitting third-party data consult with those who collected the data where possible to avoid duplication of effort and data in OWQ's database.

# 4 Types of Data Accepted through the External Data Framework

Waterbody-specific water quality data may be submitted through the EDF for surface waters throughout the state of Indiana. The EDF was developed to accommodate water quality data collected from lotic waters (rivers and streams) as well as lentic waterbodies (lakes and reservoirs). The EDF cannot accept water quality data from wetlands at this time. While the EDF is not designed to accommodate statistical results, submittal of waterbody-specific data used to generate them is encouraged.

Some OWQ uses listed in Table 1 require multiple lines of evidence or rely on criteria that must be calculated from one or more dependent parameters. These are shown in Table 5 along with the additional information required.

Tables 2-4 in this section identify the parameters, grouped by data type, that OWQ considers appropriate for its own uses and some of the most common water quality issues of interest to the water resources community:

- Parameters for water column samples and measurements and the uses to which their results may be applied (Table 2)
- Biological communities and habitat evaluations and the uses to which their results may be applied (Table 3)
- Parameters for fish tissue samples and the uses to which their results may be applied (Table 4)

Water monitoring results may be submitted with or without corresponding flow data. Flow data collected at the time of sampling is useful to OWQ, regardless of use, because this information provides

context in which to better understand sampling results. More information on monitoring flow is provided in Section 5.4.2 of this guidance.

Organizations interested in monitoring for any parameters not shown in these tables may contact the Secondary Data Coordinator for assistance in selecting appropriate sampling and analytical methods based on their project needs, as well as help in evaluating which use(s) in Table 1 their data may be appropriate.

## 4.1 Water Chemistry, Bacteriology, Algal Biomass and Field Parameters

Table 2 contains the water chemistry, bacteriology, algal biomass and field parameters most commonly monitored for the uses identified in Table 1.

**Table 2: Parameters for water column samples and measurements and the uses to which their results may be applied.**

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| General Chemistry And Physical Properties | | | |
| % Water Column with at Least 0.1 ppm Dissolved Oxygen | L-WCOXIC | A12, A13, A14 B1, B2, B3 | |
| 1% Light Level Depth | L-LightLev1 | A12 | |
| Bromide | 24959-67-9 | | A9 |
| Chlorides, Total | 16887-00-6 | A13, A14, B1, B2, B3 | A1, A2, A5, A6 |
| Chlorine, Intermittent, Total Residual | 7782-50-5 | A13, A14, B3 | A1, A2, A9 |
| Cyanide, Chlorine Amenable | 57-12-5 | | A1, A2 |
| Cyanide, Total | 57-12-5 | | A5, A6, A9 |
| Cyanide, Weak Acid Dissociable (also known as Free Cyanide) | 57-12-5 | A13, A14, B3 | A1, A2 |
| Dissolved Oxygen | E-14539 | A13, A14, B1, B2, B3, B4 | A1, A2, A7, A9 |
| Dissolved Oxygen (at a depth of 5 feet) | E-14539 | A12, A13, A14 B1, B2, B3 | |
| Stream Flow | | A13, A14, B1, B2, B3 | All Uses for Stream Data |
| Fluoride | 16984-48-8 | A12, B4 | A1, A2, A9 |
| Hardness (as CaCO3) | E-11778 | A12, A14, B1, B2, B4 | A1, A2 |
| Light Transmission (% at a depth of 3 feet) | L-TRANS3 | A12, A13, A14 B1, B3 | |

[4] OWQ's Watershed Assessment and Planning Branch chemists assign non-numeric identifiers for parameters that do not have a CAS number assigned by the Chemical Abstracts Service of the American Chemical Society. These identifiers are in most cases derived from the U.S. EPA Identification Number (U.S. EPA substance Registry Services) or from the legacy U.S. EPA STORET number listed in the test method.

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| pH (Field) | E-10139 | A13, A14, B1, B2, B3, B4 | A1, A2, A7, A9 |
| Secchi Depth (Transparency) | SECCHI | A12, A13, A14, B1, B2, B3 | |
| Settleable Matter (Residue) | | | A9 |
| Specific Conductance (also known as Conductivity) | E-10184 | A13, B1, B2, B3, B4 | A5, A6 |
| Solids, Suspended Total (also known as TSS) | E-10151 | A13, A14, B1, B2 B3, B4 | A7, A9 |
| Solids, Total (also known as TS) | E-10151 | | A9 |
| Solids, Total Dissolved (also known as TDS) | E-10173 | A13, B4 | A5, A6, A9 |
| Suspended Sediment Concentration (also known as SSC) | E-17164666 | A13, A14, B1, B2, B3, B4 | |
| Sulfate | 14808-79-8 | A13, A14, B1, B2, B3 | A1, A2, A5, A6, A9 |
| Sulfide | 18496-25-8 | | A9 |
| Sulfite | 14265-45-3 | | A9 |
| Surfactants | E-14562 | B4 | A9 |
| Surfactants, Anionic (also known as MBAS) | E-14562 | B4 | A9 |
| Surfactants, Nonionic (also known as CTAS) | E-14562 | B4 | A9 |
| Temperature | E-TEMPERATURE | A13, A14, B1, B2, B3, B4 | A1, A2, A8, A9 |
| Turbidity | E-10617 | A13, A14, B1, B2, B3, B4 | |
| Nutrients | | | |
| Nitrogen, Total Kjeldahl (also known as TKN) | E-10264 | A12, A13, A14, B1, B2, B3, B4 | A1, A2, A9 |
| Nitrogen, Ammonia | 7664-41-7 | A12, A13, A14, B1, B2, B3, B4 | A1, A2, A7, A8 A9 |
| Nitrogen, Nitrate | 14797-55-8 | A13, A14, B1, B2, B3, B4 | A5, A9 |
| Nitrogen, Nitrate+Nitrite | E-10128 | A13, A14, B1, B2, B3, B4 | A1, A2, A5, A8, A9 |
| Nitrogen, Nitrite | 14797-65-0 | A13, A14, B1, B2, B3, B4 | A5, A9 |
| Nitrogen, Total | Calculated Value | A13, A14, B1, B2, B3, B4 | |
| Nitrogen, Total Organic | Calculated Value | A12, A13, A14, B1, B2, B3 | |
| Oxygen Demand, Biochemical 5-Day (also known as CBOD5) | E-10106C5 | A13, A14, B1, B2, B3, B4 | A9 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| Oxygen Demand, Chemical (also known as COD) | E-10117 | B1, B4 | A9 |
| Phosphorus, Ortho (also known as Soluble Reactive Phosphorus and SRP) | 14265-44-2 | A12, A13, A14, B1, B2, B3, B4 | |
| Phosphorus, Total | 7723-14-0 | A11, A13, A14, B1, B2, B3, B4 | A1, A2, A7, A8, A9 |
| Total Organic Carbon (also known as TOC) | E-10195 | B4 | A9 |
| Algal Biomass | | | |
| Chlorophyll *a*, Total | 479-61-8 | A11, A12, A13, A14, B1, B2, B3 | A8 |
| Periphyton Chlorophyll *a* | E-PERI-C | A13, A14, B1, B2, B3 | A1, A2 |
| Phytoplankton Chlorophyll *a* | E-PHYTO-C | A13, A14, B1, B2, B3 | A1, A2, A8 |
| Algal Toxins | | | |
| Anatoxin-a | 64285-06-9 | B5, A13 | |
| Cylindrospermopsin | 143545-90-8 | B5, A13 | |
| Microcystins | 77238-39-2 | B5, A13 | |
| Bacteriology | | | |
| Coliform, *E. coli* | ECOLI | A13, , A14, B1, B2, B3, B4, B5 | A3, A7, A8 |
| Coliform, Fecal | FCOLI | B4 | A5, A6, A9 |
| Coliform, Total | TCOLI | | A5, A6 |
| Streptococci, Fecal | FSTREP | | A9 |
| Metals | | | |
| Aluminum, Total | 7429-90-5 | | A9 |
| Antimony, Total | 7440-36-0 | | A6, A9 |
| Arsenic, Dissolved | 7440-38-2 | A13, A14, B3, B4 | A1, A2, A6 |
| Arsenic, Total | 7440-38-2 | | A9 |
| Barium, Total | 7440-39-3 | | A7, A9 |
| Beryllium, Total | 7440-41-7 | | A7, A9 |
| Boron, Total | 7440-42-8 | | A9 |
| Cadmium, Dissolved | 7440-43-9 | A13, A14, B3, B4 | A1, A2, A6, A7 |
| Cadmium, Total | 7440-43-9 | | A9 |
| Chromium, Dissolved | 7440-47-3 | | A1, A2, A6, A7 |
| Chromium III+VI (also known as Total Chromium) | 7440-47-3 | A13, A14, B3, B4 | A9 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| Chromium VI (also known as Total Hexavalent Chromium) | 18540-29-9 | | A1, A2, A7 |
| Cobalt, Total | 7440-48-4 | | A9 |
| Copper, Dissolved | 7440-50-8 | A13, A14, B3, B4 | A1, A2, A7 |
| Copper, Total | 7440-50-8 | | A9 |
| Iron, Total | 7439-89-6 | | A9 |
| Lead, Dissolved | 7439-92-1 | A13, A14, B3, B4 | A1, A2, A5, A6 |
| Lead, Total | 7439-92-1 | | A9 |
| Magnesium, Total | 7439-95-4 | | A9 |
| Manganese, Total | 7439-96-5 | | A9 |
| Mercury, Dissolved** | 7439-97-6 | A13, A14, B3, B4 | A1 |
| Mercury, Total* | 7439-97-6 | A13, A14, B3, B4 | A2, A5, A6 |
| Methylmercury, Total | 22967-92-6 | | A6, A6 |
| Molybdenum, Total | 7439-98-7 | | A9 |
| Nickel, Dissolved | 7440-02-0 | A13, , A14, B3 | A1, A2, A6, A7 |
| Nickel, Total | 7440-02-0 | | A9 |
| Potassium, Total | 7440-09-7 | B4 | |
| Selenium, Dissolved** | 7782-49-2 | A13, A14, B3 | A1 |
| Selenium, Total* | 7782-49-2 | A13, A14, B3 | A2, A9 |
| Silver, Dissolved | 7440-22-4 | A13, A14 | A2, A7 |
| Silver, Total | 7440-22-4 | | A9 |
| Thallium, Total | 7440-28-0 | | A7, A9 |
| Tin, Total | 7440-31-5 | | A7, A9 |
| Titanium, Total | 7440-32-6 | | A9 |
| Zinc, Dissolved | 7440-66-6 | A13, A14, B3, B4 | A1, A2, A7 |
| Zinc, Total | 7440-66-6 | | A9 |
| Pesticides | | | |
| 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane (also known as 4,4’ DDD) | 72-54-8 | B1, B2 | A9 |
| 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (also known as DDE) | 72-55-9 | B1, B2 | A9 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| 4,4'-dichloro-diphenyl-trichlorethane (also known as 4-4'-DDT) | 50-29-3 | B1, B2 | A6, A9 |
| 2,4'-dichlorethylene (also known as DDT) | 789-02-6 | B1, B2 | A1, A2, A6 |
| 2,4-dichlorophenoxyacetic acid (also known as 2,4 D) | 94-75-7 | B1, B2 | |
| Aldrin | 309-00-2 | B1, B2 | A2, A8, A9 |
| Alochlor | 15972-60-8 | B1, B2 | A8 |
| Atrazine | 1912-24-9 | B1, B2 | A8 |
| BHC, Gamma (also known as Lindane) | 58-89-9 | B1, B2 | A2, A5, A6, A78, A9 |
| BHC, Alpha | 319-84-6 | B1, B2 | A9 |
| BHC, Beta | 319-85-7 | B1, B2 | A9 |
| BHC, Delta | 319-86-8 | B1, B2 | A9 |
| Carbaryl | 63-25-2 | B1, B2 | |
| Chlordane, Total | 57-74-9 | B1, B2 | A2, A5, A6, A8, A9 |
| Chloropyrifos | 2921-88-2 | B1, B2 | A2 |
| Cyclopropanecarboxylic acid (also known as Cyfluthrin) | 68359-37-5 | B1, B2 | |
| Cyhalothrin | 91465-08-6 | B1, B2 | |
| Dieldrin | 60-57-1 | B1, B2 | A1, A2, A5, A6, A8. A9 |
| Endosulfan (sum of all isomers) | 115-29-7 | B1, B2 | A2 |
| Endosulfan Sulfate | 1031-07-8 | B1, B2 | A9 |
| Endosulfan, Alpha | 959-98-8 | B1, B2 | A9 |
| Endosulfan, Beta | 33213-65-9 | B1, B2 | A9 |
| Endrin | 72-20-8 | B1, B2 | A1, A2, A6, A8, A9 |
| Endrin Aldehyde | 7421-93-4 | B1, B2 | A9 |
| Glyphosate | 1071-83-6 | B1, B2 | A8 |
| Heptachlor | 76-44-8 | B1, B2 | A2, A9 |
| Heptachlor Epoxide | 1024-57-3 | B1, B2 | A9 |
| Nicosulfuron | 111991-09-4 | B1, B2 | |
| Metalaxyl | 57837-19-1 | B1, B2 | |
| Metalochlor | 51218-45-2 | B1, B2 | A8 |
| Phostebupirim | 96182-53-5 | B1, B2 | |
| Propiconizole | 60207-90-1 | B1, B2 | |
| Parathion | 56-38-2 | B1, B2 | A1, A2, A8 |
| Toxaphene | 8001-35-2 | B1, B2 | A2, A5, A6, A9 |
| Polychlorinated Biphenyls (PCBs) | | | |
| 2,2',3,3',4,4',5 heptaCB | 35065-30-6 | | A6, A9 |
| 2,2',3,4,4',5,5' heptaCB | 35065-29-3 | | A6, A9 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| 2,3,3',4,4' pentaCB | 32598-14-4 | | A6, A9 |
| 2,3,3',4,4',5 hexaCB | 38380-08-4 | | A6, A9 |
| 2,3,3',4,4',5' hexaCB | 69782-90-7 | | A6, A9 |
| 2,3,3',4,4',5,5' heptaCB | 39635-31-9 | | A6, A9 |
| 2',3,4,4',5 pentaCB | 65510-44-3 | | A6, A9 |
| 2,3,4,4',5-pentachlorobiphenyl | 74472-37-0 | | A6, A9 |
| 2,3',4,4',5 pentachlorobiphenyl | 31508-00-6 | | A6, A9 |
| 2,3',4,4',5,5' hexachlorobiphenyl | 52663-72-6 | | A6, A9 |
| 2,3-dichlorobiphenyl | 16605-91-7 | | A6, A9 |
| 2,4,5-trichlorobiphenyl | 15862-07-4 | | A6, A9 |
| 3,3',4,4' tetrachlorobiphenyl | 32598-13-3 | | A6, A9 |
| 3,3',4,4',5 pentachlorobiphenyl | 57465-28-8 | | A6, A9 |
| 3,3',4,4',5,5' hexachlorobiphenyl | 32774-16-6 | | A6, A9 |
| Aroclor-1016 | 12674-11-2 | | A9 |
| Aroclor-1221 | 11104-28-2 | | A9 |
| Aroclor-1232 | 11141-16-5 | | A9 |
| Aroclor-1242 | 53469-21-9 | | A9 |
| Aroclor-1248 | 12672-29-6 | | A9 |
| Aroclor-1254 | 11097-69-1 | | A9 |
| Aroclor-1260 | 11096-82-5 | | A9 |
| Aroclor-1262 | 37324-23-5 | | A6, A9 |
| Dichlorobiphenyl | 2050-68-2 | | A6, A9 |
| Polychlorinated Biphenyl-154 | 60145-22-4 | | A6, A9 |
| Polychlorinated Biphenyl-171 | 52663-71-5 | | A6, A9 |
| Polychlorinated Biphenyl-200 | 40186-71-8 | | A6, A9 |
| Polychlorinated Biphenyl-47 | 2437-79-8 | | A6, A9 |
| Polychlorinated Biphenyl-98 | 60233-25-2 | | A6, A9 |
| Polychlorinated Biphenyls, Total | 1336-36-3 | | A2, A9 |
| Polycyclic Aromatic Hydrocarbons (PAHs) | | | |
| 1-methylnaphthalene | 90-12-0 | | A6 |
| 2-chloronapthalene | 91-58-7 | | A6, A9 |
| 2-methylnaphthalene | 91-57-6 | | A6 |
| 5-nitroacenaphthene | 602-87-9 | | A6 |
| 7,12-dimethylbenz(a)-anthracene | 57-97-6 | | A6 |
| Acenapthene | 83-32-9 | | A6, A9 |
| Acenapthylene | 208-96-8 | | A9 |
| Anthracene | 120-12-7 | | A9 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| Benzo (a) Anthracene | 56-55-3 | | A6, A9 |
| Benzo (a) Pyrene | 50-32-8 | | A6, A9 |
| Benzo (ghi) Perylene | 191-24-2 | | A9 |
| Benzo (b) Fluoranthene (also known as 3,4-benzofluoranthene) | 205-99-2 | | A6, A9 |
| Benzo (k) Fluoranthene | 207-08-9 | | A6, A9 |
| Chrysene | 218-01-9 | | A6, A9 |
| Dibenzo (a,h) Anthracene | 53-70-3 | | A6, A9 |
| Dibenzo (a,e) Pyrene | 192-65-4 | | A6 |
| Fluoranthene | 206-44-0 | | A9 |
| Fluorene | 86-73-7 | | A9 |
| Indeno (1,2,3-cd) Pyrene | 193-39-5 | | A6, A9 |
| Napthalene | 91-20-3 | | A6, A9 |
| Nitrobenzene | 98-95-3 | | A6, A9 |
| Oil and Grease | E-10140 | B3 | A9 |
| Phenanthrene | 85-01-8 | | A9 |
| Phenols, Total | 108-95-2 | | A6, A9 |
| Pyrene | 129-00-0 | | A9 |
| Semi-Volatile Organics (SVOCs) | | | |
| 1,2,4,5-tetrachlorobenzene | 95-94-3 | | A6 |
| 1,2-diphenylhydrazine | 122-66-7 | | A6, A9 |
| 1,2-dichlorobenzene | 95-50-1 | | A6, A9 |
| 1,3-dichlorobenzene | 541-73-1 | | A9 |
| 1,4-dichlorobenzene | 106-46-7 | | A6, A9 |
| 2,4,5-trichlorophenol | 95-95-4 | | A6 |
| 2,4,6-trichlorophenol | 88-06-2 | | A6 |
| 2,4-dichlorophenol | 120-83-2 | | A6, A9 |
| 2,4-dimethylphenol | 105-67-9 | | A5, A9 |
| 2,4-dinitrotoluene | 121-14-2 | | A6, A9 |
| 2,6-dinitrotoluene | 606-20-2 | | A6, A9 |
| 2-chlorophenol | 95-57-8 | | A9 |
| 2-nitrophenol | 88-75-5 | | A9 |
| 2,3-dinitrophenol | 51-28-5 | | A6, A6 |
| 2,4-dinitrophenol | 51-28-5 | | A5, A6, A9 |
| 2,5-dinitrophenol | 329-71-5 | | A6 |
| 3,3-dichlorobenzidene | 91-94-1 | | A9 |
| 4,6-dinitro-o-cresol | 534-52-1 | | A6, A9 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| 4-bromophenyl Phenyl Ether | 101-55-3 | | A9 |
| 4-chlorophenyl Phenyl Ether | 7005-72-3 | | A9 |
| 4-nitrophenol | 100-02-7 | | A9 |
| Benzidine | 92-87-5 | | A6, A9 |
| Benzyl Butyl Phthalate | 85-68-7 | | A6 |
| Bis (2-chloroethoxy) Methane | 111-91-1 | | A9 |
| Bis (2-chloroethyl) Ether | 111-44-4 | | A9 |
| Bis (2-chloromethyl) Ether (also known as Dichloroethyl Ether) | 111-44-4 | | A6 |
| Bis (2-ethylhexyl) Phthalate (also known as Di-2-ethylhexyl Phthalate and DEHP) | 117-81-7 | | A6, A9 |
| Bis (2-chloroisopropyl) Ether | 108-60-1 | | A6, A9 |
| Bis (chloromethyl) Ether (also known as BCME) | 542-88-1 | | A6, A9 |
| Dichlorobenzenes (sum of all isomers) | 25321-22-6 | | A6 |
| Dichlorobenzidine | 91-94-1 | | A6 |
| Diethyl Phthalate | 84-66-2 | | A6, A9 |
| Dimethyl Phthalate | 131-11-3 | | A6, A9 |
| Di-n-butyl Phthalate | 84-74-2 | | A6, A9 |
| Di-n-octyl Phthalate | 117-84-0 | | A6, A9 |
| Hexachlorobenzene | 118-74-1 | | A5, A6, A9 |
| Hexachlorocyclopentadiene | 77-47-4 | | A6, A9 |
| Hexachloroethane | 67-72-1 | | A5, A6, A9 |
| Isophorone | 78-59-1 | | A6, A9 |
| N-nitrosodibutylamine | 924-16-3 | | A6 |
| N-nitrosodi-n-butylamine | 621-64-7 | | A9 |
| N-nitrosodiethylamine | 55-18-5 | | A6 |
| N-nitrosodimethylamine | 62-75-9 | | A6, A9 |
| N-nitrosodiphenylamine | 86-30-6 | | A6, A9 |
| N-nitrosopyrrolidine | 930-55-2 | | A6 |
| P-chloro-M-cresol | 59-50-7 | | A9 |
| Pentachlorobenzene | 608-93-5 | | A6 |
| Pentachlorophenol | 87-86-5 | | A1, A2, A7, A9 |
| Phenol | 108-95-2 | | A6, A9 |
| Volatile Organics | | | |
| 1,1-dichloroethane | 75-34-3 | | A9 |
| 1,1-dichloroethylene | 75-35-4 | | A6, A9 |
| 1,1- dichloropropene | 563-58-6 | | A6 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| 1,1,1-trichloroethane | 71-55-6 | | A6, A9 |
| 1,1,2-trichloroethane | 79-00-5 | | A6, A9 |
| 1,1,2,2-tetrachloroethane | 79-34-5 | | A6, A9 |
| 1,2,4-trichlorobenzene | 120-82-1 | | A9 |
| 1,2 -dichloroethane | 107-06-2 | | A6, A9 |
| 1,2-dichloropropane | 78-87-5 | | A6, A9 |
| 1,2-dichloropropene | 563-54-2 | | A6 |
| 1,2-trans-dichloroethylene | 156-60-5 | | A9 |
| 1,3-dichloropropene (also known as 1,3-dichloropropylene) | 542-75-6 | | A6, A9 |
| 2,3,7,8-tetrachlorodibenzo-P-Dioxin (also known as 2,3,7,8-TCDD and Dioxin) | 1764-01-6 | | A5, A6, A9 |
| 2-chloroethylvinyl Ether | 110-75-8 | | A9 |
| 2,3-dichloropropene | 78-88-6 | | A6 |
| 3,3-dichloropropene | 563-57-5 | | A6 |
| Acrolein | 107-02-8 | | A6, A9 |
| Acrylonitrile | 107-13-1 | | A6, A9 |
| Benzene | 71-43-2 | | A6, A9 |
| Bromochloromethane | 74-97-5 | | A6 |
| Bromoform (also known as Tribromomethane) | 75-25-2 | | A6, A9 |
| Carbon Tetrachloride | 56-23-5 | | A6, A9 |
| Chlorobenzene (also known as Monochlorobenzene) | 108-90-7 | | A5, A6, A9 |
| Chlorodibromomethane | 124-48-1 | | A6, A9 |
| Chlorodifluoromethane (also known as HCFC-22) | 75-45-6 | | A6 |
| Chloroethane | 75-00-3 | | A6, A9 |
| Chlorofluoromethane (also known as HCFC-31) | 593-70-4 | | A6 |
| Chloroform | 67-66-3 | | A6, A9 |
| Chlorotrifluoromethane (also known as CFC-13) | 75-72-9 | | A6 |
| Dibromomethane | 74-95-3 | | A6 |
| Dichlorobromomethane (also known as Bromodichloromethane) | 75-27-4 | | A6, A9 |
| Dichlorodifluoromethane (also known as CFC-12) | 75-71-8 | | A6, A9 |
| Dichlorofluoromethane (also known as HCFC-21) | 74-43-4 | | A6 |
| Difluoromethane (also known as HCFC-32) | 75-10-5 | | A6 |
| Diiodomethane | 75-11-6 | | A6 |
| Ethylbenzene | 100-41-4 | | A6, A9 |
| Hexachlorobutadiene | 87-68-3 | | A6, A9 |
| Iodoform | 75-47-8 | | A6 |

| Parameter | CAS Number or OWQ Identifier[4] | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| Methyl Bromide (also known as Bromomethane) | 74-83-9 | | A6, A9 |
| Methyl Chloride (also known as Chloromethane) | 74-87-3 | | A6, A9 |
| Methyl Fluoride (also known as Fluoromethane and HFC-32) | 593-53-3 | | A6 |
| Methyl Iodide (also known as Iodomethane) | 74-88-4 | | A6 |
| Methylene Chloride (also known as Dichloromethane) | 75-09-2 | | A5, A6, A9 |
| Tetrachloroethylene | 127-18-4 | | A6, A9 |
| Toluene | 108-88-3 | | A5, A6, A9 |
| Trichloroethylene (also known as Trichloroethene) | 79-01-6 | | A6, A9 |
| Trichlorofluoromethane (also known as CFC-11) | 75-69-4 | | A6, A9 |
| Trifluoromethane (also known Fluoroform and HFC-23) | 75-46-7 | | A6 |
| Vinyl Chloride | 75-01-4 | | A6, A9 |

*For TMDLs in waters outside the Great Lakes basin only.

**For TMDLs in waters within the Great Lakes basin only.

## 4.2 Biological Communities and Habitat Evaluations

Table 3 lists the biological communities that may be used to support one or more of the uses described in Table 1. OWQ accepts monitoring results for macroinvertebrate and fish communities, and total plankton communities through the EDF. Habitat evaluations are also included in this table because they are most valuable when paired with biological community results.

Freshwater mussel communities are not included in Table 3 because such data sets are rare. Indiana law restricts the collection of mussels to only those individuals with a Scientific Purposes License from the Indiana Department of Natural Resources[5] and OWQ neither collects or uses these data for any of the purposes identified in Table 1. Organizations with results from mussel studies conducted with appropriate licensure may contact the Secondary Data Coordinator to determine the best way to submit these data.

**Table 3: Biological communities and habitat evaluations and the uses to which their results may be applied.**

| Parameter | CAS Number | Tier 2 Use | Tier 3 Use |
|---|---|---|---|
| Biological Communities, Habitat Evaluation | | | |
| Plankton, Total | Not Applicable | A12, A13, A14, B1, B2, B3 | NA |
| Fish Community | Not Applicable | A13, A14, B1, B2, B3, B4 | A1, A2, A7, A8 |
| Macroinvertebrate Community | Not Applicable | A13, A14, B1, B2, B3, B4 | A1, A2, A7, A8 |
| Habitat Evaluations | Not Applicable | A13, A14, B1, B2, B3 | A1, A2, A7, A8 |

[5] See 312 IAC 9-9-3.

## 4.3 Fish Tissue Parameters

Table 4 contains the fish tissue contaminants for which OWQ has developed assessment methods. Although OWQ's Tier 3 uses are currently limited to four parameters, OWQ welcomes fish tissue results for other contaminants. These have potential for use in developing a better understanding of how other bioaccumulative chemicals of concern, or emerging contaminants, may be impacting Indiana waters.

**Table 4: Parameters for fish tissue samples and the uses to which their results may be applied.**

| Parameter | CAS Number | Tier 2 Use (Table 1) | Tier 3 Use (Table 1) |
|---|---|---|---|
| Fish Tissue Contaminants | | | |
| Methylmercury | 22967-92-6 | | A4 |
| Mercury, Total | 7439-97-6 | | A4 |
| Polychlorinated Biphenyls, Total | 1336-36-3 | | A4 |

**Table 5: Office of Water Quality decisions that require corresponding results for more than one parameter.**

| Parameter of Interest | Use (Table1) | Additional Parameters Needed for Decision |
|---|---|---|
| Sulfate | A1, A2 | • Hardness (as CaCO3)<br>• Chloride |
| Chloride | A1, A2 | • Hardness (as CaCO3)<br>• Sulfate |
| Nutrients | A1, A2, A8, A14 | • Phosphorus, Total<br>• Nitrogen, Nitrate+Nitrite<br>• Dissolved Oxygen<br>• pH<br>• Visual Observations of excessive algae or chlorophyll a results (Periphyton, Phytoplankton or Total Chlorophyll *a*) |
| Nitrogen, Ammonia | A1, A2, A8, A12, A14 | • Temperature<br>• pH (field) |
| Potassium | A5 | Nitrogen, Ammonia |
| Dissolved Metals | A1, A2, A5 | Hardness (as CaCO3) |
| Dissolved Oxygen | A1, A2, A5, A8, A11, A14 | Temperature (not required but important in understanding results) |
| Nitrogen, Total | A5 | • Nitrogen, Nitrate<br>• Nitrogen, Nitrite<br>• Nitrogen, Ammonia<br>• Nitrogen, Total Kjeldahl |
| Nitrogen, Total Organic | A12 | • Nitrogen, Ammonia<br>• Nitrogen, Total Kjeldahl |
| Phosphorus, Total | A8, A11,A14 | • Chlorophyll *a*<br>• Parameters needed for the Indiana Trophic State Index calculation (see below) are not necessary but are useful in cases where paired Total Phosphorus and Chlorophyll *a* data together are inconclusive. |
| All fish tissue parameters | A4 | • Percent moisture<br>• Percent lipid<br>• Average total length for fishes in composite sample or total length of the fish if sampled as an individual<br>• Fish mass |
| Indiana Trophic State Index (ITSI) | A8, A12, A14 | • A multimetric index score calculated from:<br>• Phosphorus, Total<br>• Phosphorus, Ortho<br>• Nitrogen, Total Organic<br>• Nitrogen, Nitrate<br>• Nitrogen, Ammonia<br>• % Water Column at Least 0.1 ppm Dissolved Oxygen<br>• Dissolved Oxygen (at a depth of 5 feet)<br>• Light Transmission (at a depth of 3 feet)<br>• Secchi Depth (Transparency)<br>• Plankton, Total and % Bluegreen Dominance |

# 5 QUALITY ASSURANCE

Quality assurance is made up of the decisions and procedures that help to control those unmeasurable aspects of a monitoring project that can affect the reliability of the data collected. These include decisions about the type of study design to be used, site locations, frequency and timing of monitoring activities, and the selection of appropriate sampling and/or analytical techniques.

This section describes the quality assurance requirements and recommendations that OWQ evaluates when determining whether a secondary data set is reliable for one or more uses.

## 5.1 STUDY DESIGN CONSIDERATIONS

Sampling sites are selected by the EDF participant. With the exception of private ponds and wetlands, data collected on any surface water in Indiana are potentially reliable for the uses described in the EDF regardless of the scope of the study or the geographic scale over which the data are collected.

OWQ anticipates that most of the monitoring conducted by external organizations will be targeted in nature. However, statistical studies for which sites are selected randomly may also be useful to OWQ. Water quality data from such studies can be applied in a site-specific manner, and the statistical conclusions may provide supplementary information to OWQ decision-making processes.

Effluent data collected to demonstrate compliance with a permit will not be considered for OWQ uses through the EDF because the narrow scope of this type of sampling design limits the applicability of the resulting data to OWQ's decision-making processes. Although these data may be used as supplementary information in certain processes, OWQ has mechanisms other than the EDF in place to accept these data and to make them available to its programs internally.

## 5.2 SITE LOCATION CONSIDERATIONS

### *5.2.1 STREAMS*

Monitoring sites should be located sufficiently downstream from any permitted outfall to ensure that data collected represents ambient conditions of the stream in question. Likewise, if monitoring the effectiveness of best management practices, upstream and downstream sites should be close enough to the area of interest to capture ambient conditions, but not right at the edge of the field where mixing with the stream has not occurred.

The Purdue University publication, *Monitoring Water in Indiana: Choices for Nonpoint Source and Other Watershed Projects* (hereafter referred to as the *Purdue NPS Manual*) provides additional guidance on how to select stream monitoring locations based on different needs, as well as logistical factors that should be considered prior to monitoring. This manual is available online at: www.engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf.

Regardless of where the site is located, it is important for the protection of wildlife and endangered species to avoid fish spawning areas and to leave any mussels in the orientation in which they were found when monitoring streams.

### *5.2.2 LAKES AND RESERVOIRS*

Physical measurements and water samples must be collected at the deepest part of the lake for the data to be considered reliable for OWQ's Tier 2 or Tier 3 uses. However, data collected at other points in the lake may be also be reliable for other Tier 2 uses, and to the OWQ in general, in developing a better understanding of larger, more complex lakes in Indiana.

## 5.3 FREQUENCY AND TIMING OF MONITORING ACTIVITIES

OWQ's requirements and recommendations regarding the frequency and timing of monitoring activities and data minimums are provided in Table 7.

While most OWQ uses have minimum data requirements, few have specific requirements regarding the timing of sample collection. Those that do are Tier 3 uses that rely on biological community results or bacteriological monitoring data. These include Clean Water Act 305(b) assessments and Section 303(d) listing decisions for aquatic life use and recreational use and demonstrating the effectiveness of watershed restoration efforts funded by OWQ's Nonpoint Source Program.

For these uses, biological monitoring for macroinvertebrate community samples must be collected between mid-July and October, and fish communities must be sampled between June and mid-October. Bacteriological monitoring must be conducted during the recreational season, which is defined as April 1 through October 31 in Indiana's WQS. With respect to the frequency of bacteriological sampling activities, a minimum of 10 monthly grab samples may be used if the data set includes results from samples collected from April 1 through October 31. However, collecting five samples, equally spaced over a 30-day period is preferable because it provides sufficient data to calculate a geometric mean and for some uses may be required.

Lake monitoring is often conducted during the June-August timeframe as this is the time of year when lakes are most severely affected by nutrients. However, monitoring during other seasons can sometimes add to the understanding of what is occurring within a lake.

In order to determine background conditions for the purposes of developing a new National Pollutant Discharge Elimination System permit or revising an existing permit (another Tier 3 use) at least 12 monthly monitoring results for the parameter(s) that covers a broad range of conditions is preferred.

When demonstrating the effectiveness of watershed restoration efforts, the minimum number of results varies depending on the specific use. If the goal is to show that an impaired waterbody has been fully restored for an impairment identified on the 303(d) list (a Tier 3 use), the data minimums shown in Table 7 for the listed parameter would apply. If the goal is to show incremental improvements in water quality (a Tier 2 use) more data is often needed to provide sufficient evidence of improvement. In either case, OWQ must also consider the amount of time that has passed between follow-up sampling and installation of best management practices (BMPs) and other watershed restoration activities when determining the reliability of a data set for showing changes in water quality (Tier 2 and Tier 3 uses). Although the time it takes for a given BMP to result in a measurable improvement to water quality can vary,

certain practices might reasonably be expected to have a positive impact sooner than others as suggested in Table 6.

**Table 6: Guidelines on when to conduct follow-up monitoring to showwater quality improvements resulting from the implementation of best management practices.**

| When to Monitor | Practice/Activity |
|---|---|
| Stream BMPs | |
| 2 years | Cover crops, stream exclusion, manure management practices |
| 5 years | Filter strips, grassed waterways, drainage water management |
| 5-10 years | Forested riparian buffer, wetland creation |
| Lake BMPs | |
| 1-2 years | Dredging, near-shore vegetation |
| 5 years | Constructed wetlands, wetland restoration |
| 5-10 years | Sewers |

**Table 7: Use-specific requirements and recommendations regarding data minimums and the timing and frequency of monitoring activities.**

| Parameter Group | Tier 2 Use (Table 1) | Tier 2 Requirements for OWQ uses and Recommendations for non-OWQ uses | Tier 3 Use (Table 1) | Tier 3 Requirements |
|---|---|---|---|---|
| General Chemistry and Physical Properties (Streams) | A13, A14 B1, B3, B4 | Data Minimums<br>• A13: Three (3) measurements collected at least one month apart<br>• A14, B2, B3: Two (2) sets of three (3) results, three (3) collected monthly within the same season (April – October) before and three (3) collected after of implementation of measures/practices to reduce/eliminate pollutant loads (see Table 6)<br>• B1: Twelve (12) measurements collected in consecutive months<br>• B4: Four (4) measurements, one (1) collected at high flow and one (1) at low flow before and after implementation of measures to eliminate/reduce pollutant loads from MS4s or CSOs | A1, A2, A5, A6, A7 A8, A9 | Data Minimums<br>• A1, A2, A7, A8: Three (3) measurements collected at least one month apart; Uses require corresponding results for other parameters (see Table 5)<br>• A9: Twelve (12) grab samples collected monthly preferably paired with flow data |
| Nutrients (Streams) | A13, A14, B1, B2, B3, B4 | Data Minimums<br>• A13: Three (3) measurements collected at least one month apart<br>• A14, B2, B3: Two (2) sets of three (3) results for a suite of nutrient parameters (see Table 5), three (3) collected monthly within the same season (April – October) before and three collected after implementation of measures/practices to reduce/eliminate pollutant loads (see Table 6)<br>• B1: Twelve (12) measurements collected in consecutive months<br>• B4: Four (4) measurements, one (1) collected at high flow and one (1) at low flow before and after of measures/practices to reduce/eliminate pollutant loads | A3, A8, A9 | Data Minimums<br>• A3: Two (2) sets of three (3) results for a suite of nutrient parameters (see Table 5)<br>• A8: Three (3) results collected monthly within the same season (April – October) before implementation of measures/practices to reduce/eliminate pollutant loads and three (3) collected after (see Table 6)<br>• A9: Twelve (12) grab samples collected monthly preferably paired with flow data |

| Parameter Group | Tier 2 Use (Table 1) | Tier 2 Requirements for OWQ uses and Recommendations for non-OWQ uses | Tier 3 Use (Table 1) | Tier 3 Requirements |
|---|---|---|---|---|
| General Chemistry, Physical Properties, Nutrients, and Algal Biomass (Lakes) | A11, A12, A14, B3 | Data Minimums<br>• A11: Three (3) results collected over three years (consecutive or nonconsecutive); Results for each year must be from samples collected June – August with at least one result from a sample collected in August.<br>• A12: Results for all parameters needed to calculate one (1) the Indiana Trophic State Index (ISTI) score for assessment of trophic status and three (3) ISTI scores collected in three different years for assessment of lake trend requires results for multiple parameters (see Table 5)<br>• A14, B3: Two (2) results for all parameters required for the ISTI (see Table 5), one (1) collected before implementation of measures/practices to reduce/eliminate pollutant loads and one (1) collected after (see Table 6) | A5 | Data Type:<br>Nitrogen, Nitrate+Nitrite and Nitrogen, Nitrite results only<br><br>Data Minimums:<br>Three (3) measurements collected at least one month apart |
| Bacteriology (Lakes and Streams) | A13, A14, B1, B2, B4, B5 | Data Type:<br>A13, A14: *E. coli* only<br>B5: Any bacterial parameter<br><br>Data Minimums:<br>• A13, B1, B5: One (1) set of twelve (12) monthly results, with seven (7) collected during the recreational season (April – October) or one (1) set of five (5) results equally spaced over a 30-day period during the recreational seasion for calculation of geometric mean. Both types of data collected within the same period are preferable.<br>• A14, B2, B4: Preferably two (2) sets of five (5) results equally spaced over a 30-day period for calculation of geometric mean or two (2) sets of ten (10) results collected during the recreational season (April – October) at the same frequency before and after implementation of measures/practices to reduce/eliminate pollutant loads (see Table 5) | A3, A5, A6, A7, A8, A9 | Data Type:<br>• A3, A7, A8, A9: *E. coli* only<br>• A5, A6: Total Coliforms only<br><br>Data Minimums<br>• A3, A8, A9: Ten (10) grab samples or one (1) geometric mean result calculated from five (5) equally spaced samples over thirty (30) days. Sampling must have been conducted during recreational season (April – October)<br>• A7: Weekly sampling for three months (consecutive or nonconsecutive) including at least one month in July or August |

| Parameter Group | Tier 2 Use (Table 1) | Tier 2 Requirements for OWQ uses and Recommendations for non-OWQ uses | Tier 3 Use (Table 1) | Tier 3 Requirements |
|---|---|---|---|---|
| Metals (in water) (Streams) | A14 | Data Type<br>OWQ uses dissolved metals results only for the metals identified in tables 6-2 (327 IAC 2-1-6) and 8-1 (327 IAC 2-1.5-8) in Indiana's Water Quality Standards<br><br>Data Minimums<br>Six (6) results, collected monthly within the same season (April–October), three (3) collected before implementation of measures/practices to reduce/eliminate pollutant loads and three (3) collected after (see Table 6) | A1, A2, A7, A8, A9 | Data Type<br>• A1, A2, A7, A8: OWQ uses dissolved metals results only for the metals identified in tables 6-2 (327 IAC 2-1-6) and 8-1 (327 IAC 2-1.5-8) in Indiana's Water Quality Standards<br>• A9: OWQ uses total metals results only for the metals identified in tables 6-2 (327 IAC 2-1-6) and 8-1 (327 IAC 2-1.5-8) in Indiana's Water Quality Standards<br>• Data Minimums<br>• A1, A2, A7: Three (3) measurements collected at least one month apart<br>• A8: Six (6) results, collected monthly within the same season (April–October), three (3) collected before implementation of measures/practices to reduce/eliminate pollutant loads and three (3) collected after (see Table 6)<br>• A9: Twelve (12) grab samples collected monthly preferably paired with flow data |
| Pesticides (Streams) | A13, A14, B2 | Data Minimums<br>• A13: One (1) result collected during pesticide application season, preferably paired with flow data<br>• A14: Two (2) sets of three (3) results, three (3) collected monthly during pesticide application season before implementation of measures/practices to reduce/eliminate pollutant loads and three (3) collected within the same season after<br>• A14: Results must have accompanying flow data<br>• B2: Two (2) results, one (1) collected during pesticide application season before implementation of measures/practices to reduce/eliminate pollutant loads and one (1) collected during the pesticide application season after, preferably paired with flow data (see Table 6) | A1, A2, A5, A6, A9 | Data Minimums<br>• A1, A2, A5, A6: Three (3) measurements with at least one collected during pesticide application season<br>• A9: Twelve (12) grab samples collected monthly preferably paired with flow data |

| Parameter Group | Tier 2 Use (Table 1) | Tier 2 Requirements for OWQ uses and Recommendations for non-OWQ uses | Tier 3 Use (Table 1) | Tier 3 Requirements |
|---|---|---|---|---|
| PCBs (in water), PAHs, SVOCs, and VOCs (Streams) | NA | NA | A1, A2, A5, A6, A9 | Data Minimums<br>• A1, A2, A5, A6: Three (3) measurements collected at least one month apart<br>• A9: Twelve (12) grab samples collected monthly preferably paired with flow data |
| Biological Communities +/- Habitat Evaluation (Streams) | A13, A14, B1, B2, B3, B4 | Data Type:<br>• A14, B2, B3, B4: The biological community (fish or macroinvertebrates) must be the same community originally identified as impaired<br>• A13, A14: Supplemental habitat and/or physical data (turbidity and dissolved oxygen) also required<br><br>Data Minimums:<br>• A13, B1: One (1) measurement preferably paired with a corresponding habitat score and collected in the fall (mid July – October) for macroinvertebrate community samples, June – mid October for fish community samples<br>• A14, B2, B3, B4: Two (2) results, one (1) collected before and one (1) collected after implementation of best management practice, preferably collected during the same time of year<br>• A13, A14: Small differences in index scores may be attributable to differences in methods rather than real changes in aquatic conditions. Generally, the greater the differences in scores for different sites or for a single site, the more data OWQ would need in order to consider your data reliable for use in its decision-making processes. | A1, A2, A7, A8 | Data Type:<br>• A1, A2, A7: Must include fish or macroinvertebrate community results and may include both<br>• A8: Must include results for both fish and macroinvertebrate communities<br><br>Data Minimums:<br>• A1, A2, A7, A8: One (1) measurement preferably paired with a corresponding habitat score and collected in the fall (mid July – October) for macroinvertebrate community samples, June – mid October for fish community samples |

| Parameter Group | Tier 2 Use (Table 1) | Tier 2 Requirements for OWQ uses and Recommendations for non-OWQ uses | Tier 3 Use (Table 1) | Tier 3 Requirements |
|---|---|---|---|---|
| Biological Communities (Lakes) | A11, A12 | Data Type<br>• A11, A12: Total Plankton<br><br>Data Minimums<br>• A11, A12: Three (3) results collected over three years (consecutive or nonconsecutive); requires results for multiple parameters (see Table 5) | NA | NA |
| Metals and PCBs (in fish tissue) (Lakes and Streams) | NA | NA | A4 | Data Type:<br>• For metals, total Mercury and Methylmercury results only<br>• For PCBs, Total and Arochlor only<br><br>Data Minimums:<br>• For metals, one (1) trophic level weighted arithmetic mean concentration value calculated on all samples from the site from a single sampling event<br>• For PCBs, one (1) actual concentration value (including estimated values above the method detection limits) |

## 5.4 Recommendations Regarding Sampling and Analytical Methods

Decisions regarding sampling and analytical procedures are driven by an organization's intended use for the data, which may or may not result in data that are directly comparable to that collected by OWQ.

As part of the data quality assessment (described in Section 7 of this guidance) OWQ will review sampling and analytical methods employed by participants to determine if they are sensitive enough to produce representative data for OWQ's Tier 2 and Tier 3 uses.

The information presented here is intended to help participants decide what methods they might use to help ensure their monitoring results will be usable for their own needs and possibly the needs of OWQ. If monitoring is already occurring, the information here may also help identify possible changes that can improve data quality , making the resulting data set more broadly usable by OWQ and others.

Due to the regulatory nature of most Tier 3 uses, data provided by an external organization may be considered for Tier 3 uses only if the sampling and analytical methods used are comparable to those employed by OWQ.

For all Tier 1 and some Tier 2 uses, Indiana is fortunate to have two statewide volunteer monitoring programs, one devoted to stream monitoring and the other devoted to lakes. Both of these programs offer cost-effective options for monitoring water quality;with regardto the methods, the equipment, and the training provided.

The Hoosier Riverwatch Program, which is administered by OWQ, provides training to volunteers in how to monitor for a number of stream parameters suitable for many of the uses described in Table1.

IDEM also supports the Indiana Clean Lakes Program, which is administered by the Indiana University School of Public and Environmental Affairs (IU-SPEA). Indiana's Clean Lakes Program, in turn,provides manuals, training, and supplies for volunteers to learn how to take field measurements and collect lake water quality samples for analysis in the program laboratory at IU-SPEA. The OWQ considers data collected through the Indiana Clean lakes Program staff and student sampling teams to be suitable for all Tier 2 uses where lakes are concerned.

The *Purdue NPS Manual* identifies a number of methods for each of the core and supplemental parameters defined by OWQ's Nonpoint Source (NPS) Program which, together, represent some of the most important indicators of NPS pollution in Indiana. The manual provides an overview of commonly used methods, including those taught by the Hoosier Riverwatch and Indiana Clean Lakes programs; along with the types of equipment required for sampling and analysis, the time and expertise required, and their relative costs. The same manual also provides guidance for deciding which methods might be suitable to a given project depending on the parameters of interest and budget.

The National Environment Methods Index (NEMI) is another good resource for method-specific information related to water quality monitoring. NEMI is a free, searchable database of environmental methods, protocols, statistical and analytical methods and procedures. NEMI allows those who are currently monitoring, or are in the process of planning a monitoring project to select appropriate methods and/or to see how the methods they are currently using compare to those employed by OWQ and others. NEMI can be found online at: https://www.nemi.gov/home/.

### 5.4.1 *Collecting Field Measurements*

The choice of methods for collecting field measurements will depend on a project's needs and budget. Some methods are relatively simple while others are more technical and require specialized and/or expensive equipment.

OWQ recommends that results from direct-reading equipment, and observations that do not require data reduction, be recorded on field sheets. For OWQ's Tier 3 uses, field sheets must include the same types of information and level of detail as OWQ requires on its own field sheets. This is important because OWQ may need to contact the individual or organization that submitted the data set to resolve any questions that might arise. The same level of detail is preferred for OWQ's Tier 2 uses, but not required. Field observations requiring calculations may be reduced in the field and validated afterward.

### 5.4.2 *Measuring Flow*

Flow data collected at the time of sampling is useful, regardless of the decision-making process in which the data are used, because this information provides context in which to better understand sampling results.

The *Purdue NPS Manual* provides options both for obtaining continuous flow measurements and calculating continuous flow using the nearest U.S. Geological Survey stream gage data and the drainage area of interest. Organizations interested in adding flow data to their monitoring strategy are encouraged to contact the Secondary Data Coordinator for additional guidance, if needed.

OWQ's methods for collecting instantaneous flow measurements are available online at: http://monitoringprotocols.pbworks.com/f/IDEM+SurveysSOP2002.pdf. Where instantaneous flow measurements are concerned, OWQ methods are preferred for Tier 3 uses. OWQ considers the Hoosier Riverwatch method appropriate for all Tier 1 and someTier 2 uses because it provides a reasonable, cost-effective approximation of flow conditions at the time of sampling.

Regardless of the type of method used, OWQ encourages (but does not require) taking flow measurements at the time of sampling whenever possible for data submitted to the EDF.

### 5.4.3 *Water Chemistry and Bacteriological Sampling and Laboratory Analysis*

For chemical sampling and/or laboratory analyses, OWQ considers the methods documented in the following resources to be suitable for all uses in the EDF. Links to these resources online are provided in Section 9 of this guidance:

- U.S. EPA Methods for Chemical Analysis of Water and Wastes
- Standard Methods for the Examination of Water and Wastewater
- Test procedures cited in 40 CFR Part 136.3
- Drinking water test methods cited in 40 CFR Part 141
- U.S. Geological Survey Techniques of Water-Resources Investigations Reports

To ensure comparability of data for OWQ's Tier 3 uses, organizations are encouraged to use the same analytical methods that OWQ uses for parameters listed in Table 2. Information on these methods, including their associated quantitation limits[6], are provided in OWQ's Watershed Assessment and Planning Branch QAPP (Table B3-1), which is available upon request to the Secondary Data Coordinator. Organizations with results obtained using analytical procedures other than those identified in the QAPP may also contact the Secondary Data Coordinator who can assist in determining the comparability of the method(s) used.

### *5.4.4 Measures of Algal Biomass*

One of the most common and useful indicators for algal biomass is Chlorophyll *a*. However, monitoring for Chlorophyll *a* can be costly due to the expensive equipment and professional-level expertise required for laboratory analysis. Field s equipment is much less expensive, and minimal training is required in order to collect a sample. Therefore, it may be possible to cost-effectively collect Chlorophyll *a* data reliable for Tier 2 uses through partnerships between local volunteers or others involved in monitoring and laboratories that already possess the equipment and expertise necessary to analyze samples.

The Indiana Clean Lakes Program is a good example of this type of partnership. The samples collected by volunteers are analyzed by IU-SPEA under a quality assurance project plan (QAPP) approved by the OWQ. As a result, the OWQ considers any Chlorophyll *a* data collected through a partnership with IU-SPEA reliable for its Tier 2 uses. Any organization interested in obtaining Chlorophyll *a* data for one or more Indiana lakes are strongly encouraged to do so through participation in the Indiana Clean Lakes volunteer monitoring program.

Unlike IU-SPEA, the Hoosier Riverwatch Program does not have a laboratory in which to conduct Chlorophyll *a* analyses. Therefore, organizations interested in collecting Chlorophyll *a* data for rivers and streams may need to hire professionals or send their samples to a professional laboratory to get results reliable for their needs.

### *5.4.5 Biological Community Sampling and Habitat Evaluation*

Evaluating biological data is generally more complicated than water chemistry data and field measurements due to differences in methods and a number of other factors that can have a significant impact on data quality. For example, methods for sampling biological communities often vary, and the equipment used can affect sample representativeness in terms of the number of individual organisms and the diversity of taxa collected. The taxonomic level to which samples are identified determines the sensitivity of a given method, and the expertise of those performing the identifications can affect the accuracy of the results obtained.

#### *Macroinvertebrate Community Sampling*

For macroinvertebrate communities, the OWQ considers Hoosier Riverwatch methods suitable for most Tier 2 uses provided that those conducting the monitoring have attended Hoosier Riverwatch

[6] Quantitation limits are based on information provided in the test method and are used to determine whether the laboratory is running the procedure correctly and/or the equipment is set up and running properly. In cases where there is more than one method available for the same parameter, quantitation limits may also be used to help determine whether a given method will meet the sensitivity needs of the project.

training. Hoosier Riverwatch or similar methods are recommended for organizations collecting their own biological data, because the methods are cost effective and can provide reliable results for a number of water resource planning and management uses, if appropriate data quality controls are built into the study. You can find the Hoosier Riverwatch training manual and workshop schedule on the program web site at: http://www.in.gov/idem/riverwatch/. U.S. EPA's Rapid Bioassessment Protocols (RBP), which provide methods commonly used for the Indiana Department of Natural Resources' Lake and River Enhancement Studies, are also considered appropriate for Tier 2 uses. The RBP include two approaches – a single habitat approach and a multi-habitat approach – depending on the nature of the substrate in the stream reach to be sampled. These protocols are available online at: http://water.epa.gov/scitech/monitoring/rsl/bioassessment/#Table%20of%20Contents.

For Tier 3 uses, the methods employed to collect macroinvertebrate community data should be identical to those employed by OWQ. OWQ's *Multi-habitat (MHAB) Macroinvertebrate Collection Procedure* is available online at http://monitoringprotocols.pbworks.com/f/S-001-OWQ-W-BS-10-S-R0.pdf. For the calculation of OWQ's Multihabitat (mHAB) Macroinvertebrate Index of Biotic Integrity (mIBI), a taxa list and count are sufficient, assuming that the samples were collected using the same field methods and lab processing and identification methods.

If results were obtained using sampling and/or analytical methods other than those prescribed by OWQ, it is possible that IDEM may still be able to use the raw data for some Tier 3 uses assuming OWQ's measurement quality criteria for biological data are met. However, the biotic integrity indices IDEM currently uses in its water quality assessments cannot be calculated.

### *Fish Community Sampling*

With regard to fish community sampling, the EDF addresses only results collected with electrofishing equipment by organizations with a Scientific Purposes License from the Indiana Department of Natural Resources. This is because Indiana law restricts, or otherwise limits, most other methods, such that collecting a representative sample for any of the uses described in the EDF would not be possible.

For Tier 3 uses, the electrofishing methods used to collect fish community data should be identical to those employed by OWQ. OWQ's methods for sampling fish communities are described in OWQ's *Summary of Protocols: Probability Based Site Assessment* along with an addendum, which contains updates to the protocols and an equipment list therein at: http://monitoringprotocols.pbworks.com/. Calculation of OWQ's Index of Biotic Integrity (IBI) for fish requires a taxa list and count, as well as the number and type of DELT (Deformities, Erosions, Lesions and Tumors) anomalies found. If results were obtained using sampling and/or analytical methods other than those prescribed by OWQ, it is possible that IDEM may still be able to use the raw data for some Tier 3 uses assuming OWQ's measurement quality criteria for biological data are met. However, the biotic integrity indices IDEM currently uses in its water quality assessments cannot be calculated.

### *Habitat Evaluation*

Fish community and/or macroinvertebrate community results may be submitted with or without corresponding habitat data. Completing habitat evaluations at the time of sampling is highly encouraged because the information provided helps OWQ scientists to determine the extent to which habitat may be influencing these aquatic communities. OWQ uses the Qualitative Habitat Evaluation Index (QHEI) protocol.

However, any recognized method for habitat evaluation employed by trained individuals, such as the Citizen's Qualitative Habitat Evaluation method taught by the Hoosier Riverwatch Program, will help to enhance OWQ's understanding of biological community results submitted through the EDF and is considered acceptable for OWQ uses.

All habitat measures are inherently subjective to some degree and more so if the individual completing the assessment has not been properly trained. Given this, organizations interested in adding habitat data to their monitoring strategy are encouraged to acquire professional or college-level QHEI training if interested in producing Tier 3 data. Likewise they should seek Hoosier Riverwatch CQHEI training if interested in producing Tier 2 data.

#### *5.4.6 Fish Tissue Sampling Methods*

Given the high analytical costs associated with fish tissue monitoring, OWQ anticipates that few organizations will monitor fish tissue contaminants for the uses associated with Tier 2 of the EDF. For making fishable use support assessments and 303(d) listing decisions (a Tier-3 use), any data provided must use methods identical to those employed by OWQ. These methods are described in OWQ's *Standard Operating Procedure for the Handling and Preparation of Fish for Tissue Samples*, which is available upon request from the Secondary Data Coordinator. Note that these sampling methods involve electrofishing, which requires a Scientific Purposes License from the Indiana Department of Natural Resources' Division of Fish and Wildlife.

# 6 Quality Control

## 6.1 Quality Control Procedures

Quality control procedures are used to identify error in a data set. They are used in sampling and analytical processes to provide both quantitative and qualitative ways to measure the quality of a data set.

Quality controls differ depending on where in the monitoring process they are incorporated, as well as the type of data being collected. Field quality control checks are measures used to assess the quality of results collected while in the field and adherence to proper protocols when collecting samples for laboratory analysis. Laboratory quality control checks are measures used within the laboratory itself to assess the quality of data resulting from the analytical procedures performed in the laboratory.

Individuals and organizations currently monitoring can use the quality controls and procedures described in this guidance to improve the quality of the data they collect. For those that are considering whether or not to use data sets obtained from other sources, the information here can be used to determine if those data are reliable.

Tables 8-14 provide quality control measures for Tier 2 and Tier 3 uses, along with the frequency at which they should be used for the different types of data that OWQ anticipates receiving through the EDF. This section provides the number and type of quality control procedures OWQ considers appropriate to Tier 2 and Tier 3 uses. These vary based on data type and where in the monitoring process they are employed. They are organized by data type and whether they are employed in the field or laboratory:

- Quality control checks and frequencies for field data (Table 8)

- Quality control checks and frequencies for laboratory analyses of water and fish tissue samples (Tables 9 and 10)
- Quality controls for field collection, handling and laboratory analyses of algal biomass (Table 11)
- Quality control checks and frequencies for fish community sampling and taxonomic identification in the field (Table 12)
- Quality control checks and frequencies for collection and taxonomic identification of fish voucher specimens (Table 13)
- Quality control checks for field collections and processing of benthic macroinvertebrate community samples (Table 14)
- Quality control checks for laboratory processing and taxonomic identification of macroinvertebrate samples (Tables 15-16)

This section also addresses a number of other procedures that help to identify error in a data set; such as those which occur with sample preservation and holding times, custody procedures, and equipment calibration.

In order to determine the reliability of secondary data for one or more of the uses described in the EDF, OWQ will evaluate the quality control procedures and results provided with the data set as described in Section 7.

## 6.2 Other Procedures to Ensure Data Quality

### *6.2.1 Field Instrument Testing and Calibrations*

Measurement equipment requires periodic testing, calibration or standardization in order to produce accurate results. The procedures for these quality controls are specific to the equipment used and are typically described in the equipment manual and/or in the relevant standard operating procedures.

The frequency at which testing, calibration and standardization procedures are implemented varies based on the intended use of the data. OWQ's requirements and recommendation for the testing and calibration of equipment are provided, where applicable, in Tables 8-16.

### *6.2.2 Sample Preservation and Holding Times*

Sample preservation is an important element of quality control. Preservation techniques vary by parameter and method. However, there are some general guidelines that should always be observed.

Water samples should be preserved and immediately cooled to 4°C (+/-2°C) upon collection and should remain cooled until the time of analysis. Any visible reaction between the sample and added chemical preservative should be noted in the field record.

Fish tissue samples should be kept at a temperature of less than4°C and must be stored at the laboratory at less than -10°C until prepared. Once thawed, tissue samples should be extracted within 24 hours.

Holding times, preservation and storage requirements for specific parameters can vary by method. This information is usually provided in the method documentation and can also be found for a number of

parameters in 40 CFR Part 136.3, Table II (see Resources, Section 9). OWQ will review the documentation accompanying each data set to determine if the holding time requirements specified in the methods used have been met.

### *6.2.3 CUSTODY REQUIREMENTS*

Chain of custody is also an important element of data quality. OWQ recommends that chain of custody procedures be documented for all Tier 2 and Tier 3 uses, and is required for all OWQ uses. Chain of custody forms need not be submitted with your data but should be available to OWQ upon request to help resolve any questions regarding sample preservation, holding times, etc.

Example custody forms are included in Appendix 2. These forms illustrate the level of detail regarding the tracking of samples from field to laboratory that OWQ will look for in its data quality assessment of data sets for OWQ Tier 2 or Tier 3 uses. OWQ encourages the use of these or similar forms to ensure that the amount and type of information necessary to resolve any questions, regarding sample preservation, hold times, etc., can be provided should they arise.

Most analytical laboratories can provide a chain of custody form to their customers that will contain all the necessary information.

**Table 8: Quality control checks and frequencies for field data.**

| Parameters and Test Procedure | Field Duplicates | | Field Instrument Calibration | | Calibration Verification Standard | | Field Blanks[7] | |
|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Sample collection (Lakes) | One out of every 10 samples | One out of every 10 samples | Once per sampling event for each lake sampled | Once per sampling event for each lake sampled | NA | NA | One out of every 10 samples | One out of every 10 samples |
| Sample collection (Streams) | One out of every 20 samples | One out of every 20 samples | NA | NA | NA | NA | One field blank per sampling event | One field blank per sample set and one trip blank per sample set for bacteria |
| Measurements Collected in the Field with Electronic Instruments | | | | | | | | |
| Physical Measurements (Lakes) | NA | NA | Once at each sampling site per sampling event | Once at each sampling site per sampling event | Once for every two measurements | Once for every two measurements | NA | NA |
| Physical Measurements (Streams) | NA | NA | Equipment should be calibrated according to manufacturer's instructions annually and inspected prior to each sampling trip/event | Equipment is calibrated according to manufacturer's instructions annually and inspected prior to each sampling trip/event | NA | One measurement per trip/event verified using a second meter | NA | NA |
| Dissolved Oxygen and pH (Lakes) | 5% of all measurements | 5% of all measurements | NA | NA | NA | NA | | NA |

[7] A sample set is the set of samples collected over a given time period for a site or group of sites. These sites are generally sampled in a single trip or sampled event.

| Parameters and Test Procedure | Field Duplicates | | Field Instrument Calibration | | Calibration Verification Standard | | Field Blanks[f] | |
|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Dissolved Oxygen and pH (Streams) | Dissolved Oxygen: NA<br><br>pH: One per sampling trip/event | Dissolved Oxygen: NA<br><br>pH: One for every 10 measurements | Dissolved Oxygen: Equipment calibrated prior to each sampling trip/event<br><br>pH meter calibrated with pH buffer standards prior to each sampling trip/event | Dissolved Oxygen: Equipment calibrated prior to each sampling trip<br><br>pH meter calibrated with pH buffer standards prior to each sampling trip | Dissolved Oxygen: NA<br><br>pH: One out of every 10 measurements verified with a second meter | Dissolved Oxygen: Winkler DO measured once per sampling trip<br>pH: Once per sampling trip measurements verified with a second meter | NA | NA |
| Total Residual Chlorine (Streams) | NA | NA | No calibration required | No calibration required | NA | NA | One field blank per sampling trip/event | One field blank at each location |
| Turbidity and Conductivity (Streams) | NA | NA | Equipment calibrated prior to each sampling trip/event | Equipment should be calibrated prior to each sampling trip<br><br>One of every 20 measurements should be verified using secondary standards | Once per trip/event | Once per trip/event | NA | NA |
| Measurements Collected with Field Chemistry Kits and Other Equipment | | | | | | | | |
| Secchi Depth (Lakes) | Each measurement should be taken twice | Each measurement should be taken twice | NA | NA | NA | NA | NA | NA |

| Parameters and Test Procedure | Field Duplicates | | Field Instrument Calibration | | Calibration Verification Standard | | Field Blanks[f] | |
|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Dissolved Oxygen, pH and Chemistry Parameters (Streams) | Each test should be duplicated at least once per trip/event | 5% of all measurements | NA | NA | NA | NA | Expiration dates on reagents for all field chemistry tests should be checked prior to each sampling event | NA |
| Transparency measured with a transparency tube (Streams) | Each measurement should be taken twice | NA | Equipment should be clean such that the measurement scales are clearly visible | NA | One measurement per trip/event should be verified by a second person | NA | NA | NA |
| Temperature | NA | NA | Thermometers should be calibrated annually | Thermometers are calibrated annually | NA | NA | NA | NA |

**Table 9: Quality control checks and frequencies for laboratory analyses of water and fish tissue samples.**

| Parameter Groups and Test Procedure | Laboratory Instrument Calibration and/or Verification | | Laboratory Duplicate Sample | | Matrix Spike/Matrix Spike Duplicate | | Laboratory Control Sample (LCS) or Lab Fortified Blank (LFB) | | Method Blank | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| General Chemistry (Lakes) | Prior to each test with five serial dilutions of a standard and a blank | Prior to each test with five serial dilutions of a standard and a blank | One replicate every 10 samples | One replicate every 10 samples | NA | NA | One for every 10 samples | One for every 10 samples | Once for every sampling event or analysis set | Once for every sampling event or analysis set |
| General Chemistry (Streams) | Once prior to the analysis of samples | Once for every sampling event or analysis set | One for every 20 samples | One for every 20 samples | One for every 20 samples | One for every 20 samples | Every other sampling event or analysis set | Once for every sampling event or analysis set | Once for every sampling event or analysis set | Once for every sampling event or analysis set |
| Physical Properties (Lakes) | NA | NA | One for every 20 samples | One for every 20 samples | NA | NA | Once for every sampling event or analysis set | Once for every sampling event or analysis set | Once for every sampling event or analysis set | Once for every sampling event or analysis set |
| Physical Properties (Streams) | NA | NA | One for every 20 samples | One for every 20 samples | NA | NA | Once for every sampling event or analysis set | Once for every sampling event or analysis set | Once for every sampling event or analysis set | Once for every sampling event or analysis set |
| Bacteriology | NA | NA | | Once for every sampling event or analysis set | NA | NA | One media control sample for each media lot[8] | One media control sample for each media lot[9] | Once for every sampling event or analysis set | Sterile lab water blank once per day |

[8] Recommended media control samples include: Positive *Klebsiella pneumoniae* (KP) culture, Negative *Pseudomonas aeruginosa* (PA), and a Positive *Escherechia coli* (EC) culture.
[9] Required media control samples include: Negative total coliform other than *Escherichia coli* and a non-coliform, , Positive *Escherechia coli* (EC) culture.

| Parameter Groups and Test Procedure | Laboratory Instrument Calibration and/or Verification | | Laboratory Duplicate Sample | | Matrix Spike/Matrix Spike Duplicate | | Laboratory Control Sample (LCS) or Lab Fortified Blank (LFB) | | Method Blank | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Nutrients | Once sampling event or analysis set | Once sampling event or analysis set | One per batch of samples | One for every 20 samples | One for every 20 samples | One for every 20 samples | Once sampling event or analysis set | Once sampling event or analysis set | Once sampling event or analysis set | Once sampling event or analysis set |
| Metals (including Mercury) | Once prior to the analyses of samples | One for every 10 samples | One per batch of samples | One for every 20 samples | One for every 20 samples | One for every 20 samples | One for every 20 samples | One for every 20 samples | Once sampling event or analysis set | Once sampling event or analysis set |
| Pesticides | Once prior to the anaylsis of samples | Daily | One per batch of samples | One for every 20 samples | NA | NA | One for every 10 samples | One for every 10 samples | One for every 20 samples or one per extract batch | One for every 20 samples or one per extract batch |
| Polychlorinated Biphenyls (PCBs) | Once prior to the anaylsis of samples | Daily | One per batch of samples | One for every 20 samples | NA | NA | One for every 10 samples | One for every 10 samples | One for every 20 samples or one per extract batch | One for every 20 samples or one per extract batch |
| Polycyclic Aromatic Hydrocarbons (PAHs) | Once prior to the analysis of samples | Daily | One for every 20 samples | One for every 20 samples | NA | NA | One for every 10 samples | One for every 10 samples | One for every 20 samples or one per extract batch | One for every 20 samples or one per extract batch |
| Semi-Volatile Organic Compounds | Once prior to the analysis of samples | Daily | One for every 20 samples | One for every 20 samples | NA | NA | One for every 20 samples | One for every 20 samples | One for every 20 samples or one per extract batch | One for every 20 samples or one per extract batch |

| Parameter Groups and Test Procedure | Laboratory Instrument Calibration and/or Verification | | Laboratory Duplicate Sample | | Matrix Spike/Matrix Spike Duplicate | | Laboratory Control Sample (LCS) or Lab Fortified Blank (LFB) | | Method Blank | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Volatile Organic Compounds | Once prior to the analysis of samples | Daily | One for every 20 samples | One for every 20 samples | NA | NA | One for every 20 samples | One for every 20 samples | One for every 20 samples or one per extract batch | One for every 20 samples or one per extract batch |

**Table 10: Additional quality control checks and frequencies for laboratory analyses of water and fish tissue samples.**

| Parameter Groups and Test Procedure | External Quality Control Standard | | Surrogate | | Serial Dilution[10] | | Interference Check | | Maximum Holding Time[11] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| General Chemistry (Lakes) | One for every 10 samples | One for every 10 samples | NA | NA | NA | NA | NA | NA | • 7 days for solids<br>• 14 days for Cyanide and alkalinity<br>• 28 days for other parameters | |
| Nutrients (Lakes) | One for every 10 samples | One for every 10 samples | NA | NA | NA | NA | NA | NA | • 48 hours for filtered samples of soluble reactive phosphorus<br>• 28 days for other nutrient parameters | |
| General Chemistry (Streams) | One per day | One for every sampling event or analysis set | NA | NA | NA | NA | NA | NA | • 7 days for solids<br>• 14 days for Cyanide and alkalinity<br>• 28 days for other parameters | |
| Nutrients (Streams) | One for every sampling event or analysis set | One for every sampling event or analysis set | NA | NA | NA | NA | NA | NA | • 48 hours for filtered samples of soluble reactive phosphorus<br>• 28 days for other nutrient parameters | |

[10] A serial dilution may be needed during sample preparation in the laboratory to ensure that results measured are within the calibration range of the method.

[11] Maximum holding time is the maximum time a sample should be held prior to completion of the sample extraction and/or analysis or as required in by the method.

| Parameter Groups and Test Procedure | External Quality Control Standard | | Surrogate | | Serial Dilution[10] | | Interference Check | | Maximum Holding Time[11] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Bacteriology | One positive and one negative per day | One positive and one negative per sample run | NA | NA | When needed as indicated in the analytical method used | When required | NA | NA | 6 hours | |
| Metals (except Mercury) | One for every 20 samples | One for every 20 samples | NA | NA | One per sample run with dilutions | One per sample run with dilutions | Two per sample run | Two per sample run | 6 months | |
| Mercury | One for every 20 samples | One for every 20 samples | NA | NA | One per sample run with dilutions | One per sample run with dilutions | Two per sample run | Two per sample run | 28 days | |
| Pesticides | One per day | Four per day | Every sample | Every sample | NA | NA | NA | NA | 7 days | |
| Polychlorinated Biphenyls (PCBs) | One per day | Four per day | Every sample | Every sample | NA | NA | NA | NA | 7 days | |
| Polycyclic Aromatic Hydrocarbons (PAHs) | One per day | Four per day | Every sample | Every sample | NA | NA | NA | NA | 7 days | |
| Semi-Volatile Organic Compounds | One per day | Four per day | Every sample | Every sample | NA | NA | NA | NA | 7 days | |
| Volatile Organic Compounds | One per day | Four per day | Every sample | Every sample | NA | NA | NA | NA | 14 days | |

**Table 11: Quality controls for collection, handling and laboratory analyses of algal biomass.**

| Indicator | Blanks and Duplicates (Field) | | Sample Storage and Holding Time (Field) | | Sample Storage and Holding Time (Laboratory) | | Blanks and Duplicates (Laboratory) | |
|---|---|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Chlorophyll *a* (Total) | Field blanks should be collected for one in every 10 samples | Field blanks should be collected for one in every 10 samples | Samples stored on ice in a cooler until transferred to laboratory freezer | Samples stored on ice in a cooler until transferred to laboratory freezer | 21 days in freezer | 21 days in freezer | Duplicate for one is every 10 samples | Duplicate for one is every 10 samples |
| Periphyton Chlorophyll *a* | Duplicate samples are collected at 20% of sites | Duplicate samples are collected at 10% of sites | Samples stored on ice in a cooler until transferred to laboratory freezer | Samples stored on dry ice and in a dark place until filtered | Samples are stored in darkness and frozen for a maximum of 21 days | Samples are stored in darkness and frozen for a maximum of 24 days<br><br>Freezer temperature is monitored daily | Filters are processed in duplicate and a blank filter is run for every trip/event using deionized water | Filters are processed in triplicate and a blank filter is run for every site using tap water |
| Phytoplankton Chlorophyll *a* | | | | | | | | |

**Table 12: Quality control checks and frequencies for fish community sampling and taxonomic identification in the field.**

| Indicator | Check Integrity of Sample Containers and Labels | | Electrofishing Set-Up | | Standardization Procedures | |
|---|---|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Fish Community | Sample containers are clean and labels intact | | Initial set-up completed by experienced fisheries biologist and adjustments are made to the pulse width and voltage to ensure effective sampling and minimize injury/ mortality | | The distance fished and time spent collecting should be consistent with the sampling method used<br><br>Time spent collecting should be measured with a stopwatch and sampling times documented in the data set. | The distance and direction fished should be standardized to IDEM protocols (15x the wetted width, 50m min – 500m max).<br><br>Time spent shocking may vary according to distance sampled, but should be measured with a stopwatch and documented in the data set. |
| | Comparable Effort Checks | | Field Processing | | | |
| | Tier 2 | Tier 3 | Tier 2 | | Tier 3 | |
| | No fewer than two people netting at the same time is recommended (if using a small boat, one netter and the driver may also net) | No fewer than two people netting at the same time is required. In small streams, person operating anode could be considered a netter if actively collecting fish. | Fish are released in a location that prevents the likelihood of recapture<br><br>Samples identified in the field by an aquatic biologist with experience in taxonomic identification using standard taxonomic references and keys. A bibliography of all references used is maintained and submitted with the data set | | Immobilized fish are netted immediately and deposited into livewell or holding pen until all shocking is complete.<br><br>Fish are released in a location that prevents the likelihood of recapture if electrofishing to continue.Once all electrofishing complete, fish are released back in the sampling reach.<br><br>Samples identified in the field by a fisheries biologist with experience in taxonomic identification using standard taxonomic references and keys. A bibliography of all references used is maintained and submitted with the data set | |

**Table 13: Quality control checks and frequencies for collection and taxonomic identification of fish voucher specimens.**

<table>
<tr><th rowspan="2">Indicator</th><th colspan="2">Taxonomic Quality Control</th><th colspan="3">Vouchering</th></tr>
<tr><th>Tier 2</th><th>Tier 3</th><th>Tier 2</th><th colspan="2">Tier 3</th></tr>
<tr><td rowspan="4">Fish Community</td><td>.<br>Prior to sampling, 5% of sites should be randomly selected for vouchering a few representative individuals of all species found at the site and re-identified by another fisheries biologist</td><td>Prior to sampling, 10% of sites are randomly selected for vouchering a few representative individuals of all species found at the site and re-identified by a fisheries biologist external to the organization</td><td>For 5% of all sites, a complete set of vouchers are retained for all species collected at the site<br><br>For each fish field taxonomist, a complete set of vouchers are retained for all species collected during the sampling season<br><br>Vouchers may consist of either preserved specimens or digital images representative of all species encountered during the sampling season, even common species<br><br>Vouchers of uncertain specimens should be retained at the discretion of the fish field taxonomist and separately from the official set of species voucher specimens</td><td colspan="2">For 10% of all sites, a complete set of vouchers are retained for all species collected at the site<br><br>Vouchers may consist of either preserved specimens or digital images representative of all species in the sample, even common species<br><br>For each fish field taxonomist, a complete set of vouchers are retained for all species collected during the sampling season<br><br>Vouchers of uncertain specimens should be retained at the discretion of the fish field taxonomist and separately from the official set of species voucher specimens</td></tr>
<tr><td colspan="2">Sample Preservation, Storage and Holding Time</td><td colspan="2">Duplicate Samples</td><td colspan="2">Use of Widely/Commonly Accepted Taxonomic References</td></tr>
<tr><td>Tier 2</td><td>Tier 3</td><td>Tier 2</td><td>Tier 3</td><td>Tier 2</td><td>Tier 3</td></tr>
<tr><td colspan="2">Fish retained for laboratory identification or vouchers are preserved in the field with 10% buffered formalin and remain in the solution for a minimum of two weeks to properly preserve the specimens<br><br>Prior to handling in the laboratory, fish are removed from the formalin, and soaked or rinsed with water; Any samples to be retained are stored in glass jars with ethanol or isopropyl alcohol</td><td>5% of all sites should be revisited and sampled a second time by a partial or complete change in field team members;<br>Equipment type, voltage, and duration should be the same<br><br>Revisit should occur no less than two weeks after first sampling event to allow communities to recover</td><td>10% of all sites are revisited and sampled a second time by a partial or complete change in field team members (the same individuals may conduct the sampling but a different person should control the anode);<br>Equipment type, voltage, and duration should be the same<br><br>Revisit should occur no less than two weeks after first sampling event</td><td colspan="2">Standard taxonomic references and keys are used in identification and a bibliography of all references used is maintained and submitted with the data set</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | | | to allow communities to recover | |

**Table 14: Quality control checks for field collections and processing of benthic macroinvertebrate community samples.**

<table>
<tr><td rowspan="2">Indicator</td><td colspan="2">Check Integrity of Sample Containers and Labels (Field)</td><td colspan="4">Sample Collection</td></tr>
<tr><td>Tier 2</td><td>Tier 3</td><td colspan="2">Tier 2</td><td colspan="2">Tier 3</td></tr>
<tr><td rowspan="4">Macroinvertebrate Community</td><td colspan="2">Any sample containers used for samples to be identified in the laboratory or for vouchering are clean and labels intact</td><td colspan="2">For samples to be identified in the field:<br>• At least 45 minutes should be spent collecting and counting the number of organisms.<br>• Representatives of any new or unusual taxa should be vouchered<br><br>For samples collected for laboratory identification or vouchering:<br>• Samples should be kept moist at all times to prevent desiccation.<br>• Larger predaceous invertebrates should be immediately preserved to reduce the chance that other specimens will be damaged</td><td colspan="2">Samples are kept moist at all times to prevent desiccation<br><br>A representative selection of larger invertebrates are immediately preserved during the pick to reduce the chance that other specimens will be damaged</td></tr>
<tr><td colspan="2">Duplicate Samples</td><td colspan="2">Sample Processing (Field)</td><td colspan="2">Sample Storage (Field)</td></tr>
<tr><td>Tier 2</td><td>Tier 3</td><td>Tier 2</td><td>Tier 3</td><td>Tier 2</td><td>Tier 3</td></tr>
<tr><td>Duplicate samples should be collected at 5% of sites</td><td>Duplicate samples must be collected at 10% of sites</td><td>Any samples collected for laboratory identification or vouchering should be preserved in ethanol or isopropyl alcohol</td><td>Samples are properly preserved for long term storage with either ethanol or isopropyl alcohol. Formalin may also be added for samples with a large amount of biomass.</td><td>Any samples collected for laboratory identification or vouchering should be should be stored in a cool, dark place until transfer to laboratory<br><br>Samples should be stored upright in tightly sealed containers.</td><td>Samples are stored in a cool, dark place until transfer to laboratory<br><br>Samples should be stored upright in tightly sealed containers.</td></tr>
</table>

**Table 15: Quality control checks for laboratory processing and taxonomic identification of benthic macroinvertebrate samples.**

| Indicator | Holding Time | | Sample Processing (Accuracy in Picking and Sorting) | |
|---|---|---|---|---|
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Macroinvertebrate Community | Samples may be identified in the field or laboratory<br><br>Sample jars are periodically checked and ethanol changed if sample material appears to be degrading | Preserved samples can be stored indefinitely<br><br>Sample jars are periodically checked and ethanol changed if sample material appears to be degrading | For samples analyzed in a laboratory, one out of every 10 samples analyzed should be examined by a different analyst to remove any additional organisms missed by the first analyst. | All sample residuals are examined by a different analyst to remove any additional organisms missed by the first analyst. |
| | Taxonomic Nomenclature | | Taxonomic Identifications | |
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| | Hoosier Riverwatch nomenclature is acceptable but scientific nomenclature is preferred | Scientific nomenclature and unique entry codes are used in all identifications | Hoosier Riverwatch Manual is acceptable for samples identified in the field<br><br>Standard taxonomic references and keys should be used for laboratory identifications and a bibliography of all references used should be maintained and provided with the data set | Standard taxonomic references and keys are used in identification and a bibliography of all references used is maintained and submitted with the data set |

**Table 16: Additional quality control checks for laboratory processing and taxonomic identification of benthic macroinvertebrate samples.**

<table>
<tr><th rowspan="2">Indicator</th><th colspan="2">Reference Collection</th><th colspan="2">Precision in Sample Sorting and Enumeration</th></tr>
<tr><th>Tier 2</th><th>Tier 3</th><th>Tier 2</th><th>Tier 3</th></tr>
<tr><td rowspan="4">Macroinvertebrate Community</td><td>A reference collection consisting of each new taxon identified should be maintained regardless of whether samples are identified in the field or laboratory</td><td>Laboratory maintains a reference collection consisting of each new taxon identified</td><td>For samples to be identified in the field, the first sample collected during the sampling trip/event should be resorted and recounted by another sampler<br><br>One out of every 20 samples identified in a laboratory should be re-sorted and organism counts checked</td><td>10% of samples are re-sorted and organism counts checked</td></tr>
<tr><td colspan="2">Duplicate Identifications to Determine Taxonomic Precision</td><td colspan="2">Taxonomic Reasonableness Checks</td></tr>
<tr><td>Tier 2</td><td>Tier 3</td><td>Tier 2</td><td>Tier 3</td></tr>
<tr><td>For samples identified in the field, one sample identified by each analyst should be randomly selected for whole sample re-identification by a different analyst<br><br>One out of every 20 samples identified in the laboratory by a single analyst should be randomly selected for whole sample re-identification by a different analyst</td><td>At least 10% of all samples completed per taxonomist randomly selected for whole sample re-identification by a different taxonomist</td><td>Any new or unusual species vouchered or in samples analyzed in the laboratory should be checked against the list of Indiana aquatic insect species (see Resources, Section 9).</td><td>Any new or unusual species vouchered or in samples analyzed in the laboratory should be checked against the list of Indiana aquatic insect species (see Resources, Section 9).</td></tr>
</table>

# 7 Office of Water Quality's Data Quality Assessment Process for Secondary Data

OWQ's data quality assessment process follows the process outlined in its standard operating procedure (SOP) Methods and Procedures for the Assessment of Secondary Data, which is available by request from the Secondary Data Coordinator. This process involves to main steps:

1. Review of quality assurance and other documentation provided with the data package and verification that it contains all the information needed to determine the quality of the data set and that method and
2. Data validation, which is a parameter- and sample-specific process in which the the data are evaluated against quantitative and qualitative data quality indicators to identify any error and determine the analytical quality of the data set.

## 7.1 Data Quality Review and Verification

Verification is the process of evaluating the data set as a whole to ensure that the submittal is complete and the data package contains all the information necessary to validate the data. This includes both the quality assurance documentation and results for any quality control procedures implemented (see Tables 8-16).

The first step in the data quality assessment process is a review of the documentation provided with the data set to determine if there is sufficient information to conduct a data quality assessment and, if so, how thorough an assessment can be made. Quality assurance documentation may include a single document such as a quality assurance project plan (QAPP) or a combination of documents, including:

- Any project-specific planning documents that describe the study design, identify the analytical equipment and methods used, and document the quality assurance and quality control procedures, etc.
- Standard Operating Procedures (SOPs) that describe field, laboratory, or other relevant processes
- Published sampling or analytical methods
- Other documents that describe any non-standard analytical methods used

A QAPP is preferable because it is designed to include all the information needed to answer any questions OWQ may have regarding the accompanying data. OWQ provides a template and online guidance to assist EDF participants in the development of a QAPP at:
http://www.in.gov/idem/nps/3383.htm

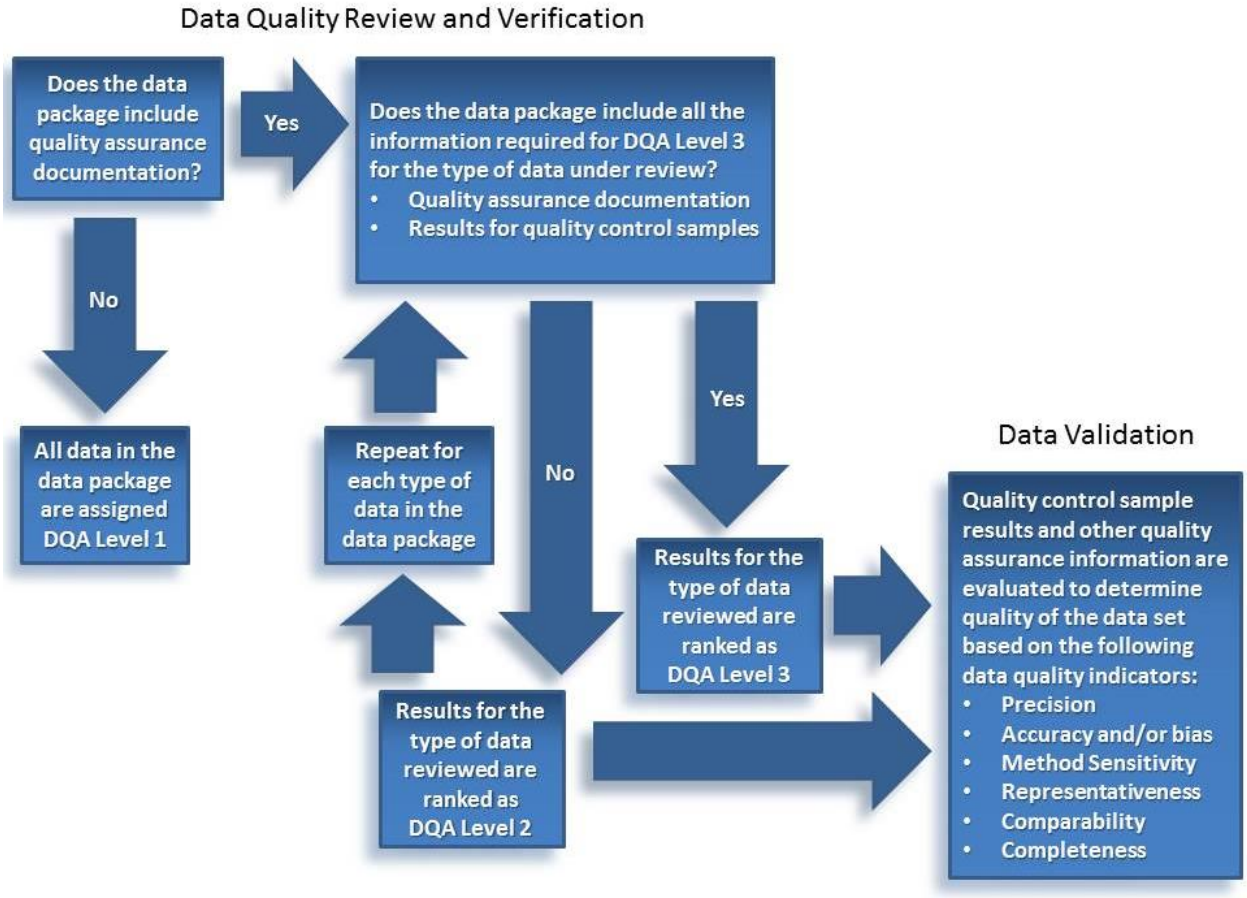
In addition to the quality assurance documentation, OWQ also reviews each type of data in the data package to verify that it includes results for any quality control procedures identified in Tables 8-16 for the following data types[12]:

- Field data (in-situ water chemistry and physical properties)
- General chemistry and bacteriological data (results from water samples)
- Nutrient data (results from water samples)
- Metals data (results from water and fish tissue samples)
- Organics data (results from water and fish tissue samples)
- Biological community (results for fish, macroinvertebrate, and plankton communities) and habitat data
- Algal biomass data (results from water samples)

Each type of data in the data package is assigned one of three possible data quality assessment (DQA) levels based on the type and amount of quality assurance information included with the data package and the degree to which it can be used to determine the quality of the monitoring results. This process is illustrated in a general way in Figure 2. The requirements specific to each type of data, are described in detail in OWQ's SOP, *Methods and Procedures for the Assessment of Secondary Data*. This certification form in Appendix 1 shows the types of information OWQ looks for when conducting its data quality review and can be used as a checklist by those submitting data for Tier 2 and Tier 3 uses to help ensure they have all the information necessary to attain the DQA Level 2 or 3 ranking. Note that this form applies only to chemistry and bacteriological data. OWQ is currently developing a similar review process for biological and algal biomass data. Until this process is fully developed and documented, these data will be evaluated by OWQ biologists based on the applicable DQOs provided in this guidance.

[12] At this time, OWQ's standard operating procedure describing its *Methods and Procedures for the Assessment of Secondary Data* addresses only chemistry and bacteriological data. OWQ is currently developing a similar review process for biological and algal biomass data. Until this process is fully developed and documented, these data will be evaluated by OWQ biologists based on the applicable DQOs provided in this guidance.

**Figure 2: Office of Water Quality's data quality assessment process.**




## 7.2 Data Validation

Validation is the next step in the data quality assessment process. The purpose of data validation is to characterize the quality of the data set. Data quality cannot be determined for DQA Level 1 submittals due to a lack of sufficient quality assurance documentation to perform the data quality assessment. To determine the data quality characteristics of DQA Level 2 and DQA Level 3 data sets, OWQ evaluates the results for each type of data provided in the data set for quantitative and qualitative data quality indicators, including:

- Precision
- Accuracy and/or bias
- Method sensitivity
- Representativeness
- Comparability
- Completeness

For data quality indicators that can be measured quantitatively, such as precision, accuracy and bias, OWQ evaluates at least 10% of the individual results against the results for the quality control samples and procedures identified in Tables 8-16. For data quality indicators that are more

qualitative in nature, including representativeness, method sensitivity and comparability, the data set is evaluated using the quality assurance documentation provided.

During the data validation process, any questionable results are flagged and any limitations on the use of individual results or data sets as a whole are noted. During the validation process, each data set is also reviewed to determine if it has all the information necessary to upload the data into OWQ's AIMS database.

OWQ's decision regarding the DQA of a given data set is considered final. However, OWQ will attempt to follow-up with the secondary data provider to resolve any questions regarding the data submittal, if available staff and time allows.

Once the DQA level and EDF tier is determined for the data set, the only question remaining is whether or not it meets the requirements for a given use. These requirements and how they are used to determine the usability of a validated data set for OWQ and other uses are described in the following section.

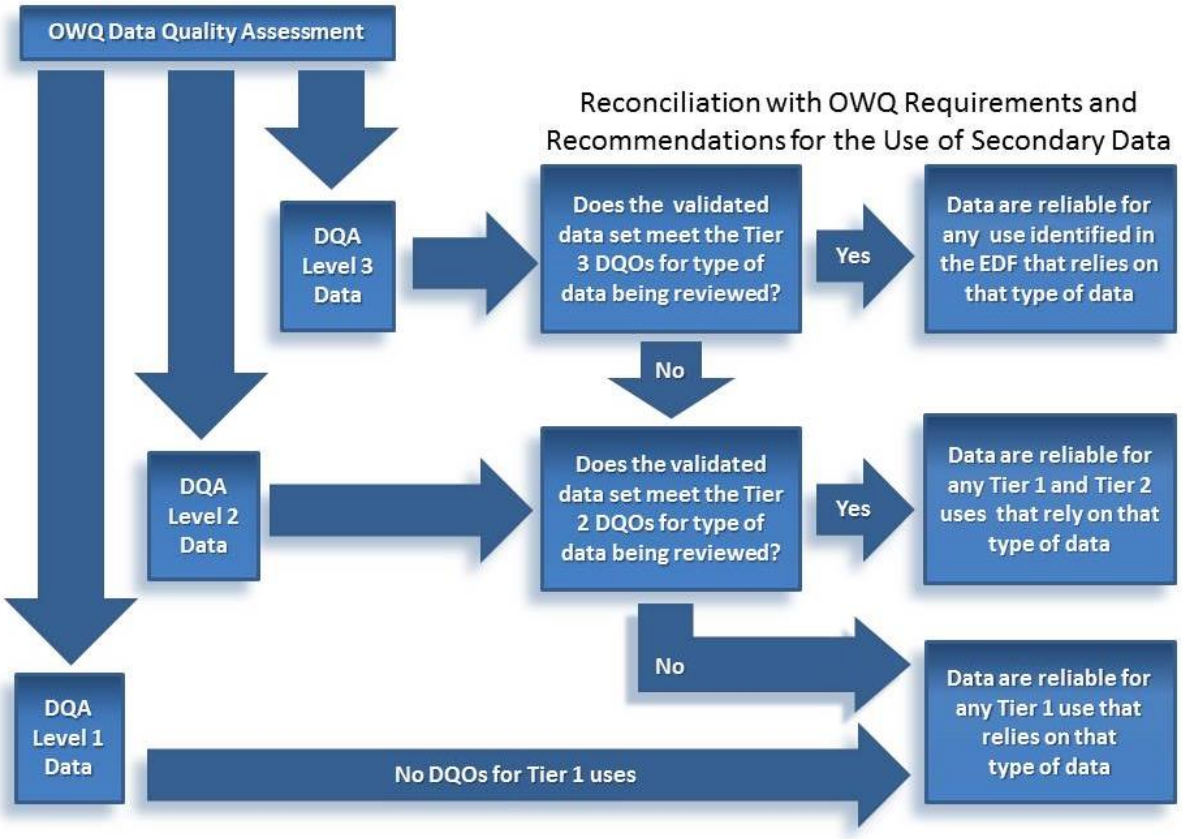
# 8 Reconciliation with Office of Water Quality Requirements for the Use of Secondary Data

All results validated through OWQ's data quality assessment process are considered potentially reliable for OWQ uses. This is accomplished by comparing the quality assurance data and information provided with the validated data set against DQOs established for a given EDF tier for the type of data under consideration (Figure 3). DQOs are based on qualitative and quantitative characteristics of a data set that, together, describe the data quality needed to support its intended use(s).

In order to use secondary data that has been validated, OWQ must reconcile the data set with the requirements specific to the intended use. In addition, some OWQ uses have other specific requirements; such as corresponding results for more than one parameter or data minimums (Table 5). For information on how OWQ programs apply secondary data in their decision-making processes, participants should refer to the supporting documentation for the OWQ program of interest. Links to the OWQ programs identified in Table 1 are provided in the resources at the end of this guidance (Section 9).

OWQ's decision regarding the usability of a given external data set is considered final where OWQ uses are concerned. This may or may not affect how others decide to use data made available through the EDF process. Individuals and organizations should make these determinations on their own. All individuals and organizations submitting data to OWQ through the EDF will be notified of OWQ's review results and the OWQ processes for which their data may be used by OWQ. Those interested in working with OWQ to improve the quality of their data to qualify it for OWQ's Tier 3 uses are encouraged to contact the Secondary Data Coordinator.

**Figure 3: Office of Water Quality's process for determining the reliability of a secondary data set for a given use, based on data quality objectives.**




## 8.1 Data Quality Objectives for Tier 1 Uses

The EDF does not provide DQOs for Tier 1 because DQOs cannot be established for data of unknown quality. Tier 1 is included in the EDF in recognition of the fact that such data still have value and are potentially useful, albeit in limited ways. Any data submitted through the EDF may be applied to all Tier 1 uses described in Table 1.

## 8.2 Data Quality Objectives for Tier 2 and Tier 3 Uses

OWQ has established data quality objectives (DQOs) for a number of important data quality indicators in order to determine whether a secondary data set is reliable for one or more Tier 2 and Tier 3 uses described in the EDF. Monitoring conducted by external organizations is typically driven by different needs than those of OWQ and, as a result may have different data quality objectives. Once the quality of a secondary data set is assessed and a DQA level assigned, OWQ must evaluate the results against its own DQOs to determine if the data are reliable for its uses. Similarly, external organizations may use the DQOs established here to determine if data they have, or plan to collect, or have obtained from other sources are reliable for their uses.

DQOs are evaluated qualitatively as part of the overall quality assurance process associated with the data set as described in Section 7. Other data quality objectives are stated in quantitative terms and are evaluated using the results from the data quality controls built into the study design.

DQOs for laboratory analysis of water and fish tissue samples, field measurement, and biological communities are discussed in the following section. These DQOs are considered minimum data quality requirements for OWQ uses and are provided as recommendations for other, non-OWQ uses.

In addition to reviewing your results for accuracy and precision, OWQ will review the quality assurance information included with the data package to determine the reliability of the results for OWQ uses. The sensitivity of sampling and analytical methods used and their comparability to OWQ methods are also important considerations for determining whether your data are reliable for OWQ uses.

The frequency and timing of sampling activities, and the location of sampling sites, will be reviewed to identify any bias that may exist and to evaluate the potential effect of said bias on OWQ decision-making. Completeness is another important aspect of data quality and is defined within the context of user needs, usually in terms of minimum data requirements. OWQ defines completeness of a given data set within the context of the decision(s) it may be used to support. Thus, completeness objectives will vary depending on the intended use(s) of the data. Minimum data requirements for OWQ uses and the appropriate parameter types and recommendations for other uses are provided in Table 7

### 8.2.1 *Data Quality Objectives for Field Data and Laboratory Analyses for Chemistry and Bacteria*

OWQ's DQOs for laboratory analyses of chemistry and bacteriological samples are expressed in terms of precision and accuracy.

*Bias*

To measure bias from contamination of field blanks, warning and control limits can be established based on the standard deviation of the associated sample set:

$$SD = \sqrt{\frac{(|x_1 - \bar{x}| + |x_2 - \bar{x}| + \cdots |x_3 - \bar{x}|)^2}{(n-1)}}$$

Where:
x = sample result;
$\bar{x}$ = mean of all sample results;
n = total number of samples.

*Precision*

Precision is a measure of the degree to which two or more measurements are in agreement. In the laboratory, the relative percent difference (RPD) can be used to measure precision in the analysis of duplicate samples. Almost all laboratory analytical methods for chemistry articulate a range that can be expected for the RPD in duplicate samples if the method is run properly.

In most cases, this is defined in terms of the standard deviation (SD) of the mean RPD of all duplicates run on a given day. For most chemistry methods, the acceptable range for precision is +/- 2 SD. Results within this range, or that meet the range demonstrated with the laboratory's statistical process control data, are considered applicable for Tier 3 uses. Qualified results may be

acceptable for some Tier 3 uses. Therefore, it is important to include definitions for any data qualifiers and flags associated with any results in the data set (see Table 18 for the flags OWQ uses to qualify results).

OWQ's Tier 2 uses do not require analytical precision to be quantified with the use of duplicate samples. However, including this quality control is highly encouraged for all Tier 2 uses based on the credibility and reliability that quantifying precision can lend to a data set.

For precision in bacteria results, OWQ's Tier 3 DQO is less than 125% RPD. This value is based on OWQ's statistical process control results.

The RPD is calculated with the following equation:

$$RPD = \frac{(|(S - D)| \; x \; 100)}{(S + D \; x \; 0.5)}$$

Where:
*S* = the first sample value (original or matrix spike value);
*D* = the second sample value (duplicate or matrix spike duplicate value).
Accuracy is the degree to which an observed value and an accepted reference value agree. Percent recovery (%R) of reference standards is calculated as follows:

$$\%R = \frac{\big((A - B) \; x \; 100\big)}{C}$$

Where:
*A* = the analyte concentration determined experimentally with known quantity of reference material added;
*B* = the background concentration determined by separate (unspiked) analysis of sample or in the field, a blank;
*C* = the true value of the reference standard added.

*Accuracy*

As with RPD above, almost all laboratory analytical methods articulate a range that can be expected for the percent recovery of a reference standard if the method is run properly. Therefore, for all laboratory results for chemistry, the Tier 3 DQO for accuracy, stated in terms of percent recovery will be the range stated in the method. For laboratories that are able to provide statistical process control data, results within the ranges demonstrated is also considered applicable for Tier 3 uses. As with field data, qualified results may be acceptable for some Tier 3 uses provided that any flags used are defined in the documentation provided with the data set.

OWQ's Tier 2 uses do not require accuracy of chemistry results to be quantified with the use of reference standards. However, including this quality control is highly encouraged for all Tier 2 uses because, regardless of the intended use, more confidence may be placed in results for which accuracy has been quantified.

For bacteria results, OWQ's DQOs for accuracy are based on whether or not the media used in the analyses have been tested to ensure their sensitivity. If media control tests are run and the results indicate that they are sensitive, the data are considered accurate for Tier 3 uses. The media controls required for Tier 3 uses are:

- A sterility control sample (*E. coli*, Fecal Coliform and Total Coliforms)
- Pseudomonas aeruginosa (PA) Negative (E. coli)
- Klebsiella pneumoniae (KP) Positive Culture (E. coli)
- *Escherichia coli* (EC) Positive Culture (*E. coli*)

OWQ does not require media control sample results for its Tier 2 uses but recommends the use of such quality control measures in the laboratory to improve the reliability of the results obtained.

**Table 17: Data quality objectives for field measurements.**

| Field Quality Control Measurement | Precision (as measured with duplicates) | | Bias (as measured in field blanks) | | Field Calibration Verification | |
|---|---|---|---|---|---|---|
| | EDF Tier 2 | EDF Tier 3 | EDF Tier 2 | EDF Tier 3 | EDF Tier 2 | EDF Tier 3 |
| Lakes | +/- 2 SD | +/- 2 SD | Warning Limits:<br>Upper and lower warning limits are defined as +/- 2 SD<br>Detections above the upper warning limit are considered suspect but usable<br><br>Control Limits:<br>Upper and lower control limits are defined as +/- 3 SD<br>Detections above the control limit are rejected | Warning Limits:<br>Upper and lower warning limits are defined as +/- 2 SD<br>Detections above the upper warning limit are considered suspect but usable<br><br>Control Limits:<br>Upper and lower control limits are defined as +/- 3 SD<br>Detections above the control limit are rejected | | |
| Streams | <40 RPD | <40 RPD | Results for field blanks should be less than the reporting limit (typically 3.18 X the detection limit). For detections above the reporting limit:<br>• Results <5x the blank contamination are rejected<br>• Results between 5-10x the blank contamination are considered estimated<br>• Results >10x the blank contamination are considered actual values | Results for field blanks must be less than the reporting limit (typically 3.18 X the detection limit). For detections above the reporting limit:<br>• Results <5x the blank contamination are rejected<br>• Results between 5-10x the blank contamination are considered estimated<br>• Results >10x the blank contamination are considered actual values | <25 RPD for pH and turbidity results obtained with different meters or with different test methods<br><br><25 RPD for Winkler dissolved oxygen results | <20 RPD for pH and turbidity results obtained with different meters or with different test methods<br><br><20 RPD for Winkler dissolved oxygen results |

**Table 18: Laboratory data qualifiers and flags.**

| Flags | Description |
|---|---|
| R | Rejected – Result is not acceptable for use in decision making process. |
| J | Estimated – The use of the result in decision making processes will be determined on a case by case basis. |
| U | Between MDL and RL – The result of the parameter is above the Method Detection Limit (MDL) but below the Lab Reporting Limit (RL) and will be estimated. |
| Q | QC Checks or Criteria – One or more of the Quality Control (QC) checks or criteria are out of control. |
| D | RPD for Duplicates – The Relative Percent Difference (RPD) for a parameter is outside the acceptable control limits. The parameter will be considered estimated or rejected on the basis listed below:<br>If the Sample or Duplicate value is less than the RL, and the other value exceeds 5 times the MDL, then the sample will be estimated.<br>If the RPD is outside the established control limits (max. RPD) but below two times the established control limits (max. RPD), then the sample will be estimated.<br>If the RPD is twice the established control limits (max. RPD) or greater, then the sample will be rejected. |
| B | Blank Contamination – This parameter is found in a field or lab blank. Whether the result is accepted, estimated, or rejected will be based upon the degree of contamination as described below.<br>If the result of the sample is greater than the reporting limit but less than five times the blank contamination, the result will be rejected.<br>If the result of the sample is between five and ten times the blank contamination, then the result will be estimated.<br>If the result of the sample is less than the reporting limit or greater than ten times the blank contamination, the result will be accepted. |
| H | Holding Time – The analysis for this parameter was performed out of the holding time.<br>The results will be estimated or rejected on the basis listed below:<br>If the analysis was performed between the holding time limit and 1.5 times the holding time limit, the result will be estimated.<br>If the analysis was performed outside the 1.5 times the holding time limit, the result will be rejected. |

### *8.2.2 Data Quality Objectives for Biological Data and Habitat Evaluations*

In general, OWQ's DQOs for biological community data and habitat evaluations are based on the sampling methods used and their comparability to OWQ methods, the taxonomic level of identification, and the level of taxonomic expertise of the individual(s) performing the identifications.

As with chemical data, OWQ will evaluate each study design and sampling strategy to determine if they are capable of providing data that are representative for the intended OWQ use. The completeness of a data set for OWQ uses will also be evaluated[13]. This review and OWQ's determinations will be made with submission of the full set of documentation needed, usually with the first data submission. Documentation of any changes to a study design and/or sampling strategy should be provided with subsequent data submissions, so that OWQ can determine if such changes affect the usability of the data.

[13] The EDF evaluates completeness in two ways. For the purposes of OWQ's data quality review and verification process described in Section 7, OWQ defines completeness in terms of whether the data package has all the information necessary to complete the data quality review and enter the data into the AIMS database. To determine whether the data set is reliable for a given use as described in this section, OWQ defines completeness in terms of the amount and type of valid data needed for the intended use.

For Tier 2 uses, Hoosier Riverwatch or other biological sampling methods are acceptable. For OWQ's uses, the methods used must allow for reliable identification of organisms to the family level. In addition, all individuals performing identifications must be able to provide proof of their completion of the basic Hoosier Riverwatch training course or equivalent expertise. These data quality requirements are suitable for other Tier 2 uses because they are sensitive enough to answer the questions for which they were collected, and they lend credibility to the data upon which potentially important decisions will be based.

For Tier 3 uses, biological community data must be directly comparable to OWQ data. Comparability will be evaluated using the method documentation provided with the data set. OWQ will review the sampling procedures and equipment used to ensure they are functionally identical to those used by OWQ in its biological community sampling. The quality assurance and quality control techniques used by an organization will also be evaluated, and the data submitted must meet the DQOs shown in Table 19.

For fish community data, OWQ will consider only results collected with electrofishing equipment by organizations with a Scientific Purposes License from the Indiana Department of Natural Resources. This is because Indiana law restricts or otherwise limits most other methods such that collecting a representative sample for any of the uses described in the EDF would not be possible.

In addition to the comparability of the methods and equipment used to collect fish samples OWQ will review the data set for the stream distance sampled and records regarding the amount of time spent and voltage used duringelectrofishing. OWQ will also review the taxonomic references used in the identifications of vouchers. The Resources Section at the end of this guidance contains a link to an online list of the primary taxonomic references OWQ uses in its biological sample identifications.

For macroinvertebrate data sets, OWQ will review the documentation to determine if all the necessary steps in OWQ's multihabitat sampling procedures were followed, as this is critical to collecting a representative community sample for OWQ uses. OWQ's SOP detailing these procedures is available online at: http://monitoringprotocols.pbworks.com/f/S-001-OWQ-W-BS-10-S-R0.pdf. For macroinvertebrate samples identified in a laboratory, OWQ will also look at the type of microscope used and the taxonomic references consulted.

The biological data OWQ collects and uses in its decision-making processes are community data meaning that they measure the characteristics of the entire biological community (fish or macroinvertebrates) as opposed to individual species. Given this, studies that target certain families or species would not produce sufficient data to calculate results that OWQ requires for Tier 3 uses even if other data quality criteria are met.

The completeness of a data set will also be evaluated within the context of OWQ's needs. While a single biological community result per site may be considered complete for some of OWQ's Tier 2 uses, the use of these data for Tier 3 uses are contingent on also having results for all the metrics necessary to calculate OWQ's Index of Biotic Integrity (IBI) for fish communities and/or the multihabitat (MHAB) macroinvertebrate index of biotic integrity (mIBI).

All individuals performing identifications for Tier 3 uses must have professional experience in taxonomic identification of the organism group(s) monitored. A brief statement of qualifications for each taxonomist must be included with the data quality documentation submitted with the initial data set in order for OWQ to determine the usability of it and all subsequent data sets provided. Given the importance

of taxonomic expertise to the reliability of results, qualification statements must be included in any subsequent data submissions for which new taxonomists begin to perform identifications.

For OWQ Tier 3 uses, voucher specimens of all taxa sampled must be maintained for both fish and macroinvertebrates, as they may be requested by OWQ to address any questions of taxonomic accuracy of the data set that cannot otherwise be resolved with the information provided.

For Tier 3 uses, taxonomic identifications must be made to the level necessary to enable calculation of biotic integrity scores. For fish community samples, all fish greater than 20 millimeters in length are identified to the species level (whereas fish less than 20 millimeters in length are not included in the sample) in order to calculate OWQ's IBI. To calculate OWQ's MHAB mIBI, specimens are identified to the lowest practical taxon; generally the genus or species level, if possible and practical. In some instances, family-level or higher identifications are acceptable, such as with leeches, water mites, some snails and several families of true flies. Some specimen identifications must be made at the species level in order for OWQ to consider the data reliable for use in calculating a mIBI score.

For macroinvertebrates, the power of the microscopes under which dissections and identifications are performed is also an important consideration in determining the reliability of data for Tier 3 uses. This should be indicated in the documentation provided with the initial data set. OWQ recommends that laboratories be equipped with one or more dissecting microscope scopes with a magnification range of 0.67 to 5x and 10x eyepieces to provide a total magnification range of 6.7-50x. Identifications must be performed using a compound microscope with a magnification range from 40x-1000x and equipped with phase contrast capabilities.

Precision in identification of biological samples is calculated as Percent Taxonomic Disagreement (PTD) by comparing the taxonomic results with the results of whole sample re-identifications for macroinvertebrates and voucher specimens at 10% of fish community sites:

$$PTD = \left[1 - \left(comp_{pos}/N\right)\right] x\ 100$$

Where:
$comp_{pos}$ = the number of agreements;
$N$ = the total number of individuals in the larger of the two counts.

The lower the PTD, the more similar taxonomic results are and the better overall taxonomic precision. A DQO of 15% is recommended for taxonomic difference or disagreement (overall mean less than or equal to 15% is acceptable based on similar projects) for benthic macroinvertebrates and fish. Individual samples exceeding 15% should be examined for taxonomic areas of substantial disagreement and the reasons for disagreement investigated. This DQO applies to both fish and macroinvertebrate community data. Generally, periphyton samples have a higher PTD due to the variance among species.

Percent sorting efficiency (PSE) is a measure of accuracy in the sorting and subsampling of macroinvertebrate samples for identification. For Tier 3 uses, the qualifications of any individual(s) doing the sorting and subsampling must be initially determined. This is accomplished by having a second analyst use a 6-10x scope to check all residuals from the first five samples processed by the sorter. If the PSE is 90% or better, the sorter is considered qualified. Once qualified, 10% of the sorter's samples should be randomly selected and checked to ensure a high PSE is maintained.

$$PSE = \frac{A}{A + B} \times 100$$

Where:
*A* = the number of organisms found by the primary sorter;
*B* = the number of recoveries (organisms missed by the primary sort and found during the QC check).

Sample enumeration is a component of taxonomic precision in the identification of macroinvertebrate samples. Sample enumeration agreement must be checked with the same 10% of samples used to check taxonomic precision. Final specimen counts for samples are dependent on the taxonomist, not the rough counts obtained during the sorting activity.

Comparison of counts is quantified by calculation of percent difference in enumeration (PDE), calculated as:

$$PDE = \left(\frac{|n1 - n2|}{n1 + n2}\right) x\ 100$$

Where:
*n1* = the number of specimens counted in a sample by the first taxonomist;
*n2* = the number of specimens counted by the second taxonomist.

A DQO of 5% is recommended (overall mean of less than or equal to 5% is acceptable) for several biological samples while others will have higher PDEs.

Taxonomic accuracy is evaluated by having individual specimens representative of selected taxa identified by experienced taxonomists. Samples should be identified using the most appropriate technical literature that is accepted by the taxonomic discipline and reflects the accepted nomenclature. The Integrated Taxonomic Information System (ITIS), which is available online at: http://www.itis.gov/ can be used to verify nomenclatural validity and reporting.

Reference collections must be maintained as samples are identified in the laboratory. For macroinvertebrates, this collection must consist of one or more voucher specimens for each family and species identified for OWQ Tier 3 uses. The reference collection should also include vouchers for all questionable identifications.

**Table 19: Data quality objectives for biological community data and habitat evaluations.**

| Biological Community Data | | | | |
|---|---|---|---|---|
| Parameter or Parameter Group (by method where applicable) | Precision | | Accuracy | |
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Total Plankton | | | • Taxonomic accuracy is qualitatively evaluated based on:<br>• Individual(s) performing identifications have at least some college-level training and/or professional experience in identification of aquatic organisms<br>• Taxonomic identifications to the genera level<br>• Consistent use of nomenclature based on the taxonomic reference(s) used in identifications | • Taxonomic accuracy is qualitatively evaluated based on:<br>• Individual(s) performing identifications have at least some college-level training and/or professional experience in identification of aquatic organisms<br>• Taxonomic identifications to the genera level<br>• Consistent use of nomenclature based on the taxonomic reference(s) used in identifications |

| Biological Community Data | | | | |
|---|---|---|---|---|
| Parameter or Parameter Group (by method where applicable) | Precision | | Accuracy | |
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Fish Community Samples | Sampling Precision:<br>Three sites (minimum) are revisited at least two weeks after the initial visit and the Relative Percent Difference (RPD) for number of species is <30%<br><br>Taxonomic Precision:<br>Percent Taxonomic Disagreement (PTD) <25% for each site (calculated by comparing field identifications with voucher specimens collected for 10% of all sites sampled) | Sampling Precision:<br>10% of sites are revisited at least two weeks after the initial visit and the Relative Percent Difference (RPD) for number of species is <25%<br><br>Taxonomic Precision:<br>Percent Taxonomic Disagreement (PTD) <20% for each site (calculated by comparing field identifications with voucher specimens collected for 10% of all sites sampled) | Sampling Accuracy:<br>Consistent application of field methods including laying out the reach, proper electrofishing equipment, setting adjustments to collect a representative sample, net mesh size, direction and technique of electrofishing by trained crew members<br><br>Taxonomic Accuracy:<br>Percent Taxonomic Disagreement (PTD) <25% for each site (calculated by comparing results from 10% of all sites to results obtained by a partial or complete change in individuals sampling a site a second time)<br><br>Taxonomic accuracy is qualitatively evaluated based on:<br>• Experience and technical expertise of individual(s) performing identifications;<br>• Consistent use of accepted scientific nomenclature in all identifications | Sampling Accuracy:<br>Strict adherence to established field methods including laying out the reach, proper electrofishing equipment and setup adjustments to collect a representative sample, net mesh size, direction and technique of electrofishing by trained crew members<br><br>Taxonomic Accuracy:<br>Percent Taxonomic Disagreement (PTD) <15% for each site (calculated by comparing results from 10% of all sites to results obtained by a partial or complete change in individuals sampling a site a second time)<br><br>Taxonomic accuracy is also qualitatively evaluated based on:<br>• Experience and technical expertise of individual(s) performing identifications;<br>• Consistent use of accepted scientific nomenclature in all identifications<br>• Use of appropriate taxonomic literature or other references such as identification keys and voucher specimens |

| Biological Community Data | | | | |
|---|---|---|---|---|
| Parameter or Parameter Group (by method where applicable) | Precision | | Accuracy | |
| | Tier 2 | Tier 3 | Tier 2 | Tier 3 |
| Macroinvertebrate Community Samples | Taxonomic Precision:<br>• Percent Taxonomic Disagreement (PTD) <25% for individual samples (calculated for 10% of all samples randomly selected for whole sample re-identification), and;<br>• An overall mean of <25% for all samples (calculated as the mean of all PTD values obtained from re-identification of individual samples)<br><br>Precision in Sample Enumeration:<br>• Percent Difference in Enumeration (PDE) <10% for individual samples (calculated for 10% of all sample with results from recounting), and;<br>• An overall mean of < 10% for all samples (calculated as the mean of all PDE values obtained from recounts of the same individual samples used to calculate taxonomic precision) | Taxonomic Precision:<br>• Percent Taxonomic Disagreement (PTD) <20% for individual samples (calculated for 10% of all samples randomly selected for whole sample re-identification), and;<br>• An overall mean of <20% for all samples (calculated as the mean of all PTD values obtained from re-identification of individual samples)<br><br>Precision in Sample Enumeration:<br>• Percent Difference in Enumeration (PDE) <5% for individual samples (calculated for 10% of all sample with results from recounting), and;<br>• An overall mean of < 5% for all samples (calculated as the mean of all PDE values obtained from recounts of the same individual samples used to calculate taxonomic precision) | Percent Sorting Efficiency in sorting >75% PSE (calculated from examination of the residuals from 10% of sorted samples)<br><br>Percent Sorting Efficiency in picking >75% PSE (calculated from examination of 10% of picked samples)<br><br>Taxonomic accuracy is qualitatively evaluated based on:<br>• Individual(s) performing identifications have been certified by Hoosier Riverwatch and/or have at least some college-level training and/or professional experience in identification of aquatic organisms<br>• Taxonomic identifications to the family level<br>• Consistent use of nomenclature based on the taxonomic reference(s) used in identifications | Percent Sorting Efficiency in sorting >90% PSE (calculated from examination of the residuals from 10% of sorted samples)<br><br>Percent Sorting Efficiency in picking >90% PSE (calculated from examination of 10% of picked samples)<br><br>Taxonomic accuracy is qualitatively evaluated based on:<br>• Experience and technical expertise of individual(s) performing identifications;<br>• Taxonomic identifications to the lowest practical taxon (genus for most organisms)<br>• Consistent use of accepted scientific nomenclature in all identifications<br>• Use of appropriate taxonomic literature or other references such as identification keys and voucher specimens |
| Habitat Assessment | Precision in Field Measurements and Observations:<br>Percent difference between measurements taken by different teams should be no more than +/- 20% | Precision in Field Measurements and Observations:<br>Percent difference between measurements taken by different teams should be no more than +/- 10% | NA | NA |

# 9 RESOURCES

## 9.1 OFFICE OF WATER QUALITY RESOURCES

OWQ's EDF website: http://in.gov/idem/cleanwater/2485.htm

General Guidance for the External Data Framework: http://in.gov/idem/cleanwater/2485.htm

Links to Supporting Documentation for the OWQ uses identified in Table 1:

- The decision-making processes for Clean Water Act Sections 305(b) and 303(d) assessment and listing decisions (Tier 3 uses) and Section 314 assessments (Tier 3 uses), are described in OWQ's Consolidated Assessment and Listing Methodology (CALM): http://www.in.gov/idem/nps/files/ir_2014_report_apndx_h_calm.pdf
- Total Maximum Daily Loads: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overviewoftmdl.cfm#publicparticipation
- OWQ's NPDES Program determines representative background conditions in permits (a Tier 3 use) in accordance with U.S. EPA's Permit Writer's Manual, which describes step-by-step how permits are developed: http://water.epa.gov/polwaste/npdes/basics/upload/pwm_2010.pdf
- Antidegradation classifications (a Tier 3 use) are made in accordance with the rules articulated in Indiana's Water Quality Standards, 327 IAC 2-1.3-1: http://www.in.gov/legislative/iac/T03270/A00020.PDF
- Indiana's State Revolving Fund (SRF) loan program evaluates loan applications for drinking water and wastewater infrastructure improvements (a Tier 2 use) based on a variety of factors, which are described in the program guidance documents available online at: https://secure.in.gov/ifa/srf/2376.htm#PER

## 9.2 MONITORING GUIDANCE

Monitoring Water in Indiana: Choices for Nonpoint Source and Other Watershed Projects: www.engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf.

U.S. Geological Survey Techniques of Water-Resources Investigations Reports Book 9 - Handbooks for Water-Resources Investigations: http://pubs.usgs.gov/twri/

### *9.2.1 PARAMETERS AND SAMPLING METHODS*

Indiana Clean Lakes Program: http://www.indiana.edu/~clp/

Hoosier Riverwatch Program: http://www.in.gov/idem/riverwatch/

IDEM Office of Water Quality Monitoring Methods:

- OWQ Technical Standard Operating Procedure: *Multi-habitat (MHAB)*

*Macroinvertebrate Collection Procedure* (S-001-OWQ-W-BS-10-T-R0): http://monitoringprotocols.pbworks.com/f/S-001-OWQ-W-BS-10-S-R0.pdf

- OWQ *Summary of Protocols: Probability Based Site Assessment* (32/03/002/1999) and addendum: http://monitoringprotocols.pbworks.com/.
- OWQ Standard Operating Procedure: *Biological Studies Section Qualitative Habitat Evaluation Index (QHEI):* http://monitoringprotocols.pbworks.com/f/IDEM+QHEI+SOP.pdf

Indiana Administrative Code (IAC): http://www.in.gov/legislative/iac/T03270/A00020.PDF

- 327 IAC 3.2.6, Table 6-1 Surface Water quality Criteria for Specific Substances
- 327 IAC 2-1.5-8, Table 8-3 Metals Concentrations in Micrograms Per Lite; Hardness in Milligrams Per Liter $CaCO_3$

U.S. EPA Rapid Bioassessment Protocols:
http://water.epa.gov/scitech/monitoring/rsl/bioassessment/index.cfm

U.S. Geological Survey Techniques of Water-Resources Investigations Reports Book 1 - Collection of Water Data by Direct Measurement: http://pubs.usgs.gov/twri/

USGS document "Estimation of Regional Flow-Duration Curves for Indiana and Illinois." Scientific Investigations Report 2014-5177: http://pubs.usgs.gov/sir/2014/5177/

## 9.3 Laboratory Analytical Methods

### *9.3.1 Chemistry Samples*

U.S. EPA Methods for Chemical Analysis of Water and Wastes (SW-846):
http://www.epa.gov/osw/hazard/testmethods/sw846/online/index.htm

Standard Methods for the Examination of Water and Wastewater (available for purchase from the following site): http://www.standardmethods.org/store/

U.S. Code of Federal Regulations (CFR):

- 40 CFR Part 136.3 Identification of Test Procedures: http://www.epa.gov/region9/qa/pdfs/40cfr136_03.pdf
- 40 CFR Part 141 Subpart C, Appendix A Alternative Testing Methods Approved for Analysis Under the Safe Drinking Water Act: http://www.gpo.gov/fdsys/pkg/CFR-2012-title40-vol24/pdf/CFR-2012-title40-vol24-part141-subpartC-appA.pdf

U.S. Geological Survey Techniques of Water-Resources Investigations Reports Book 5 - Laboratory Analysis: http://pubs.usgs.gov/twri/

National Environment Methods Index (NEMI): https://www.nemi.gov/home/.

### *9.3.2 Biological Samples*

Integrated Taxonomic Information System (ITIS): http://www.itis.gov/

## 9.4 Data Quality Assurance and Quality Control

OWQ Quality Assurance Project Plan Template and Guidance: http://www.in.gov/idem/nps/3383.htm

U.S. EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process*: http://www.epa.gov/quality/qs-docs/g4-final.pdf

## 9.5 Data Submission

Assessment Information Management System (AIMS) Templates: http://www.in.gov/idem/nps/3383.htm

# 10 Where to Get Technical Assistance

Technical assistance is available for any organization with an interest in submitting their data for potential use in OWQ programs. Many useful resources are available from the EDF home page http://in.gov/idem/cleanwater/2485.htm . Here you will find links to the guidelines for data submission, monitoring guidance, technical assistance for preparing a QAPP for your data, and relevant training available through OWQ and other programs.

The Hoosier Riverwatch Program provides training for stream monitoring through several one-day workshops held throughout Indiana each year. The Hoosier Riverwatch training schedule and manual are available online at: www.in.gov/idem/riverwatch.

The Indiana Clean Lakes Program provides those interested in monitoring lakes with a monitoring manual and works with its volunteers to answer questions and help address issues that arise in their sampling activities. The Indiana Clean Lakes Program volunteer manual and other information are available at: www.indiana.edu/~clp/VMmanual.php.

Individuals and organizations interested in learning more about the EDF and how to participate are encouraged to contact OWQ's Secondary Data Coordinator:

Carol Newhouse, Secondary Data Coordinator
IDEM Office of Water Quality
100 North Senate Avenue
MC 65-44 Shadeland
Indianapolis, IN 46204-2251
317-308-3392; 800-451-6027 (toll free)
Email: WaterQualityEDF@idem.IN.gov

# 11 REFERENCES

Code of Federal Regulations (CFR). 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants, Appendix A.

Code of Federal Regulations (CFR). 40 CFR Part 141, Subpart C, Monitoring and Analytical Requirements.

Indiana Administrative Code (IAC), Title 327 Water Pollution Control Division, Article 2. Water Quality Standards. Last updated June 11, 2014. IDEM. http://www.in.gov/legislative/iac/T03270/A00020.PDF

Indiana Department of Environmental Management. 2004. *Quality Assurance Project Plan for Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program*. Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management: Indianapolis, Indiana.

Indiana Department of Environmental Management. 2010. *Surface Water Quality Monitoring Strategy 2011-2019*. Watershed Planning and Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management: Indianapolis, Indiana.

Indiana Department of Environmental Management. 2002. *Water Quality Surveys Section Field Procedure Manual*. Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management: Indianapolis, Indiana.

Department of Environmental Management. 2004. *Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program*, (Rev. 3, Oct. 2004). Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management: Indianapolis, Indiana.

Indiana Department of Environmental Management. 2010a. *Multi-habitat (MHAB) Macroinvertebrate Collection Technical Standard Operating Procedure*. S-001-OWQ-W-BS-10-T-R0. Watershed Planning and Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management : Indianapolis, Indiana.

Indiana Department of Environmental Management. 2014a. Indiana's 303(d) List of Impaired Waterbodies.

Indiana Department of Environmental Management. 2014b. *Indiana's 2014 Consolidated Assessment and Listing Methodology (CALM)*. Watershed Planning and Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management: Indianapolis, Indiana.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish – Second Edition*. EPA/841/8-99/002. Assessment and Watershed Protection Division, U.S. Environmental Protection Agency, Washington, D.C.

U.S. EPA. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA/240/B-06/001*. U.S. EPA, Office of Environmental Information, Washington D.C.

# APPENDIX 1: CERTIFICATION FORM FOR SUBMISSION OF EXTERNAL DATA FOR OWQ TIER 2 AND TIER 3 USES

# Certification Form for the Submission of External Data Sets to the Office of Water Quality, Watershed Assessment and Planning Branch (WAPB)

Submitting Authority: _____

_____

Project Name: _____

I certify that the information included on this form is complete and accurate to the best of my knowledge. I understand that incorrect or incomplete information may result in the rejection of any data submitted with this form.

Signature of Project Manager: _____ Date: _____

Signature of Quality Assurance Officer: _____ Date: _____

**Assignment to Data Quality Assessment (DQA) Level 3 -** The information listed on this form must be submitted with the data package for data to be assigned to DQA Level 3.

**Assignment to Data Quality Assessment Level (DQA) Level 2 -** The information on this form must be certified as available for review upon request from the Quality Assurance Officer or other appropriate staff of the WAPB for data to be assigned to DQA Level 2.

**Assignment to Data Quality Assessment (DQA) Level 1 -** Failure to record and store for review any element of the information listed on this form may result in all data being assigned to DQA Level 1.

**Rejection of Data Submittal -** Failure to provide at least the date, time and location of sample collection will result in those results being rejected for any use by the WAPB.

WAPB Quality Assurance Officer Comments: _____

_____

_____

_____

_____

Instructions:

Please complete this form and the checklist on the following pages to include with each data submittal. Note that this form has some informational elements that apply to all submittals and others that are specific to the type(s) of data included with the submittal. Depending on the type(s) of data you are submitting, some of the quality assurance information listed on this form may not be applicable and should be marked as such in the “NA” column.

| Quality Assurance Information Required for DQA Level 2 and DQA Level 3 Data Submissions for OWQ Uses | | | | | |
|---|---|---|---|---|---|
| **Item** | **Included with Data Submittal** | **Available to OWQ upon Request** | **Not Available** | **N/A** | **Comments** |
| | **DQA Level 3** | **DQA Level 2** | **DQA Level 1** | | |
| **Sample Information** | | | | | |
| Sampling and Analysis Work Plan or Quality Assurance Project Plan was submitted as part of the Data Package. | | | | | |
| **General Sample Information and Field Parameters** | | | | | |
| Dates of sample collection were recorded. | | | | | |
| Times of sample collection were recorded. | | | | | |
| Physical locations of sample collection were recorded. | | | | | |
| Analytical methods used with this data set were recorded. | | | | | |
| Approved detection limits were recorded. | | | | | |
| Field calibration checks were recorded. | | | | | |
| Field duplicates were collected as appropriate. | | | | | |
| Data Package included detailed listing of the preservatives used in the samples, per each individual container. | | | | | |
| **General Chemistry and Nutrients Data** | | | | | |
| Sample Prep Dates were recorded. | | | | | |
| Date of analysis was recorded for each result. | | | | | |
| Analytical method was recorded for each result. | | | | | |
| Detection limits were recorded for each parameter. | | | | | |
| Quantitation (Reporting) Limits were recorded. | | | | | |
| Blank, Field Duplicate and MS/MSD results were recorded. | | | | | |
| Instrument calibrations were recorded. | | | | | |
| Laboratory control standards results were recorded. | | | | | |
| Initial and continuing calibration results were recorded. | | | | | |
| **Metals Data** | | | | | |
| ICP Serial Dilution information was recorded. | | | | | |
| ICP Linear Range Studies information was recorded. | | | | | |
| ICP Interelement Correction Study information was recorded. | | | | | |
| ICP Interference Check Standard information was recorded. | | | | | |
| ICP CRQL Standard information was recorded. | | | | | |
| ICP/MS Mode used in the analysis was recorded. | | | | | |
| ICP/MS Stability Check with Tuning Solution information was recorded. | | | | | |

| Quality Assurance Information Required for DQA Level 2 and DQA Level 3 Data Submissions for OWQ Uses | | | | | |
|---|---|---|---|---|---|
| **Item** | **Included with Data Submittal** | **Available to OWQ upon Request** | **Not Available** | **N/A** | **Comments** |
| | **DQA Level 3** | **DQA Level 2** | **DQA Level 1** | | |
| **Organics Data** | | | | | |
| Surrogates information was recorded. | | | | | |
| Internal Standards information was recorded. | | | | | |
| System Performance information was recorded. | | | | | |
| **Bacteriological Data** | | | | | |
| Summary Data Package was compiled. | | | | | |
| Sample Prep Dates and Times were recorded. | | | | | |
| Sample Analysis Dates and Times were recorded. | | | | | |
| Holding Times were recorded. | | | | | |
| Incubation Parameters were recorded. | | | | | |
| Temperature Evaluation was conducted. | | | | | |
| Analytical Methods were recorded. | | | | | |
| Detection Limits were recorded. | | | | | |
| Quantitation (Reporting) Limits were recorded. | | | | | |
| Blank, Field Duplicate and MS/MSD results were recorded. | | | | | |
| Field and Method Duplicates were collected. | | | | | |
| Colilert Quality Control Report(s) were collated. | | | | | |
| Positive Control results were recorded. | | | | | |
| Beginning and Ending Sterility Control results were recorded. | | | | | |
| KP, PA, EC, Media Control Standards results were recorded. | | | | | |
| **Chain of Custody** | | | | | |
| Chain of Custody form was used. | | | | | |
| Chain of Custody Form included the signature of the person who collected the samples. | | | | | |
| Chain of Custody Form included the signature of the person accepting custody of the samples. | | | | | |
| Chain of Custody Form included the date that the samples were collected. | | | | | |
| Chain of Custody Form included the time that the samples were collected. | | | | | |
| Chain of Custody Form included the date that the samples were received by the Testing Laboratory. | | | | | |
| Chain of Custody Form included the time that the samples were received by the Testing Laboratory. | | | | | |
| Chain of Custody Form included the type and number of containers that were used for each sample. | | | | | |

| Quality Assurance Information Required for DQA Level 2 and DQA Level 3 Data Submissions for OWQ Uses | | | | | |
|---|---|---|---|---|---|
| **Item** | **Included with Data Submittal** | **Available to OWQ upon Request** | **Not Available** | **N/A** | **Comments** |
| | **DQA Level 3** | **DQA Level 2** | **DQA Level 1** | | |
| **Testing Laboratory** | | | | | |
| Name and address of the Testing Laboratory was recorded. | | | | | |
| Telephone number and e-mail of the Contact Person at the Testing Laboratory was recorded. | | | | | |
| Sample delivery date and time was recorded by the laboratory. | | | | | |
| Testing Laboratory Job Number was recorded. | | | | | |
| Date that the Lab Report was prepared was recorded. | | | | | |
| Date that the Lab Report was received from the laboratory was recorded. | | | | | |

# APPENDIX 2: EXAMPLE CUSTODY FORMS

## NON-BIOLOGICAL SAMPLES
## **CHAIN OF CUSTODY**

Organization Name: Project Name:

**I certify that the sample(s) listed below was/were collected by me or in my presence.**

Signature: Date: Page ___ of ___ pages

| **Event ID** (YY_ _ _ _) | **Sample #** | **Number of Bottles** | | | | | | | | | | | **Collected** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2000mL P,NM | 1000mL P,NM | 1000mL G,NM | 500mL GW,M | 250mL GWM | 125mL GWM | 40mL VIAL | 120mL P,(BO) | 500mL P,NM | 250mL P,NM | 250mL T,NM | **Date** (mm/dd/yyyy) | **Time** (24 hr) |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |
| | | | | | | | | | | | | | / / | : |

**T=Teflon P=Plastic G=Glass NM=Narrow Mouth WM=Wide Mouth (BO)=Bacteriological Only**

**I certify that I received the above sample(s).** _____

Signature of laboratory personnel receiving sample(s)

**Should samples be iced?** Y N (circle one)

| **Signature** | **Date and Time** (circle AM or PM) | **Seals Intact** (circle one) | | **Comments** |
|---|---|---|---|---|
| Relinquished By: | / / | Y | N | |
| Received By: | : AM PM | | | |
| Relinquished By: | / / | Y | N | |
| Received By: | : AM PM | | | |
| Relinquished By: | / / | Y | N | |
| Received By: | : AM PM | | | |

### Laboratory Custodian

**I certify that I received the above sample(s) and that the above sample(s) is/are recoded in the office record book. The same sample(s) will be in custody of competent laboratory personnel at all times or locked in a secure area.**

Signature: Date: Time:

| Laboratory Name: | Laboratory Address: |
| --- | --- |
| | |

# BIOLOGICAL SAMPLES
# **FIELD CHAIN OF CUSTODY**

Organization Name: Project Name:

**I certify that the sample(s) listed below was/were collected by me or in my presence.**

Signature: Date:

Sample Type:
- ☐ Fish
- ☐ Macroinvertebrate
- ☐ Algae

| **Event ID** (YY_ _ _ _)/ **Macro #** (9 DIGIT) | **Sample #** | 2000mL Nalgene | 250mL Nalgene | 125mL Glass | Type (AD or AS) | Volume(mL) | **Collected** | | **Placed in Storage** | | **Storage Room #** | **Check line for sample present and accounted for! One check per bottle.** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | **Date** (mm/dd/yyyy) | **Time** (24 hr) | **Date** (mm/dd/yyyy) | **Time** (24 hr) | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |
| | | | | | | | / / | : | / / | : | | |

| **Signature** | Date and Time (circle AM or PM) | **Comments** |
|---|---|---|
| Relinquished By: | / / | |
| Received By: | : AM PM | |
| Relinquished By: | / / | |
| Received By: | : AM PM | |

Laboratory Custodian

**I certify that I received the above sample(s) and that the above sample(s) is/are recoded in the office record book. The same sample(s) will be in custody of competent laboratory personnel at all times or locked in a secure area.**

Signature: Date: Time:

Laboratory Name: Laboratory Address:

# BIOLOGICAL SAMPLES
# LABORATORY CHAIN OF CUSTODY

| Organization Name: | Project Name: |
|---|---|
| Laboratory Name: | Laboratory Address: |

**By placing your initials below, you are certifying that the sample(s) listed below was/were processed by you or in your presence in the processing room noted below and returned to the noted storage room.**

| **Sample Type**<br>AD = Algae, Diatom<br>AS = Algae, Soft<br>F = fish<br>M = macro | **Event ID or Macro #**<br>(YY_ _ _ _) or<br>(_ _ _ _ _ _ _) | **Sample #** | # of 2000 mL Nalgene Jar | # of 250 mL Nalgene Jar | # of 125 mL Glass Jar | **Removed from Storage for Processing** | | Processing Room # | Initials | **Placed in Storage after Processing** | | Storage Room # | Initials | # of Olive Voucher Jars | # of Slides | # of Close Top Test Tubes | **Sample Spli**<br>P = Permane<br>T = Tempora |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Date (mm/dd/yyyy) | Time (24hr) | | | Date (mm/dd/yyyy) | Time (24hr) | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |
| | | | | | | | : | | | | : | | | | | | |